ELEMENTARY BOTANY

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ELEMENTARY BOTANY

BY

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WITH 275 ILLUSTRATIONS

TOGETHER WITH

A MANUAL

OF THE MORE COMMON

HERBACEOUS PLANTS

OF QUEBEC AND ONTARIO.

(ADAPTED FROM GRAY'S MANUAL.)

BY

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APPENDIX

PREFACE

In writing the present volume, I have endeavoured to place the subject before elementary students in such a way as to exercise to the full their powers of observation, and to enable them to make accurate deductions for themselves from the facts which they observe. To attempt the study of Botany without the practical examination of plants is futile. Students of plant-life *must* look at plants, and this book is specially designed for use during the process. Considerable experience as examiner in Botany as taught in schools has convinced me that comparatively few learners have the advantage of seeing specimens with the aid of a compound microscope, although the treatises usually employed should involve the frequent use of such an instrument. Under these circumstances, I have in the following pages assumed that a compound microscope is not employed, and for their proper understanding such an instrument is quite unnecessary. An ordinary inexpensive lens should be used to aid the naked eye; but, on the other hand, in commencing the study of Botany a compound microscope is absolutely needless, and, in the case of young beginners, does more harm than good. The section on Physiology has been so written that no knowledge of the histology of plants is assumed—a feature which is, I believe, here introduced for the first time. Though by no means a "cram-book" for elementary examinations, a thorough knowledge of the contents of this book will enable a candidate to pass with distinction.

In order to lay more emphasis on the observation of facts, and with a view to simplify the whole matter, I have inserted no unnecessary technical terms, but, for the convenience of students who afterward use "Floras," I have added an appendix for use as a dictionary, but not for the purpose of elementary study.

Some words of explanation may be required in reference to the definitions of *flowers* and *fruits*. In more advanced works we are told that a flower is a collection of sporophylls inserted on a simple axis. This definition seems to me imperfect. That the young carpels and stamens are homologous with leaves, and particularly with sporophylls, is proved beyond a doubt. But the mature carpel with the ripe ovules is no longer homologous with a sporophyll; it is a sporophyll containing parasitic and symbiotic gametophytes. The symbiosis of the gametophytes and the sporophylls before, during, and subsequent to fertilisation constitutes a phenomenon which is unique in the vegetable kingdom. Consequently, it appears that, when judged by the facts of the case and on historical grounds, it is at least incomplete and inexpedient to employ to the cone of *Equisetum* the same term as to the flower of a Buttercup. A single flower of a Buttercup is no more a mere collection of sporophylls than a frog is a fish because it passes through the tadpole stage. In reference to the definition of a fruit, I have followed that given in the "Lehrbuch der Botanik" written by Professors Strasburger, Noll, Schenck, and Schimper. The definition of a fruit is thus brought closer to the popular usage of the term, while we are extricated from any dilemma in reference to distinguishing between an inferior and a false fruit.

In conclusion, it should be stated that for the most part the illustrations have, after careful consideration, been specially executed by my friend Mr A. H. Church of Jesus College, Oxford, to whose skill and care I am much indebted. To him, also, I owe a careful revision of the proofs of this book. Further assistance in the matter of illustrations has been rendered by Mr A. Robinson of the University Museum, Oxford. Students who desire a simple introduction to the study of Microscopical Botany are recommended to procure Dr D. H. Scott's "Structural Botany"; while those who wish for a comprehensive work, dealing with the science as a whole, will find all they require in "The Student's Text-book of Botany," by Professor S. H. Vines. Finally, such students as desire to identify wild British plants, and to do field-work, will find Hayward's "Botanist's Pocket Book" an excellent little work which contains all the necessary information.

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PART I

GENERAL MORPHOLOGY

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CHAPTER I

INTRODUCTION

PLANTS, like animals, are living beings, and may be regarded from two standpoints. In the first place, a plant may be considered as a living machine designed to execute certain work and consisting of definite parts or *organs*, to each of which there is allotted a particular office or *function*. After this definition we naturally inquire how a plant lives, feeds, grows, and multiplies. We then ask precisely what work is performed by the various organs, such as the leaves, stems, and roots. This aspect of botany is termed **Physiology**. Again, we may look at a plant simply as a machine consisting of various parts or *members*, which are arranged in a particular order and have certain shapes. In fact, we learn the exact form of the plant without taking notice of the work it does. This department of botany is termed **Morphology**. Studied from this point of view, we find that plants exhibit resemblances to, and differences from, one another. For instance, a Fern seems very unlike a Mushroom, and yet both are alike in so far as neither of them possesses flowers. On the other hand, a tuft of Grass and a Buttercup are widely different in appearance, but at the same time they resemble each other insomuch as they both produce true seeds from flowers. These points of likeness and unlikeness among plants lead us to arrange the latter into groups. This grouping is described as **Classification,** and constitutes **Systematic Botany**. For our present purpose, let us be content to divide plants into two great classes—namely, *Flowering Plants* and *Non-Flowering Plants*. In the first group are included all plants which bear seed-producing flowers, whether they have showy blossoms such as those of the Buttercup, Wallflower, and Dandelion, or blossoms which we hardly notice, such as those of Grasses, Oaks, and Hazels. *Non-Flowering Plants* bear no seed-producing flowers: amongst

them are the Ferns, Mosses, Seaweeds, and Fungi. In this book we treat only of flowering plants, so far as they can be studied with the naked eye aided by a simple lens.

Method of using this book.—This book is divided into three Parts:—Part I. relating to General Morphology (and including a special chapter on the Scotch Pine); Part II. referring to the Classification of Angiosperms; and Part III. relating to the Physiology of plants.

Beginners should first read chapters ii. to v. in Part I., and should practically examine the roots, stems, and leaves described. They may then pass on to the study of Physiology contained in Part III. (chapters xv. to xxii.); or they may read the remaining chapters of Part I. (omitting that which relates to the Scotch Pine), at the same time studying the families specially marked at the commencement of Part II. (chapter xiv.). In this book the characters of each family are denoted by a description of one or more representatives which are *types* of that family. While a student is reading the description of one of these types, he *must* have before him a specimen of the plant described, so that he can constantly examine and refer to it. Should any point in the description be beyond the comprehension of the learner, reference should be made to the teacher or, by means of the index, to the explanations given in Part I. The families should not be studied in the exact order in which they are placed in the book: the season of the year and other considerations will determine the order in which the types are to be examined. As examples of flowers appropriate for beginners we may mention the Buttercup, Poppy, Wallflower, Pea, Rose, Primrose, Dead Nettle, Hyacinth, and Daffodil. In beginning the study of the types for the first time, students should entirely ignore, and omit to read, the characters given at the commencement of the description of each family.

If the beginner has studied the systematic portion of the book thus outlined before working at the Physiology, he should then pass on to Part III.

Finally, when the student has acted as previously advised, the whole of Part I. should be read over again: and the remaining types and families in Part II. might also be dealt with.

CHAPTER II

THE DISTINCTION OF A FLOWERING PLANT INTO ROOT AND SHOOT

EVERYONE is familiar with the fact that ordinary flowering plants possess roots, stems, leaves, and flowers. The roots of a plant constitute its **root-system**, and are usually concealed in the soil; whereas the stems, leaves, and flowers of the plant together compose the **shoot-system**, and are generally visible and above ground. But stems and leaves are occasionally embedded in the soil; whilst roots may be found raised above the ground on sub-aerial parts of the plant. Hence we cannot define a root as being the subterranean part of the plant, nor the shoot as being the sub-aerial portion. It will, therefore, be well to consider first what we mean by the terms "root" and "shoot." For this purpose the seedling of a bean may be examined. The seedling consists of a main axis, which bears certain structures—the lateral members—on its sides. The ascending portion of this axis is the **stem**, which possesses the flattened **leaves** as its lateral members. At the tip of the stem the leaves are crowded together to form a bud. The main stem may also produce lateral stems—the branches—which are like itself. The descending part of the main axis of the seedling is the main **root**, which has no leaves, and therefore does not terminate in a bud.* The root does, however, bear branches similar to itself which are called the lateral roots.

Even inside the seed of the Bean, the young plant, or embryo, displays this distinction into root and shoot. The bean-seed (fig. 1) is externally clothed by a shell-like seed-coat termed the *testa* (*ts*). The testa has a minute pore (*m*) at one end of the scar (*hi*) on its side. The whole of the space enclosed within

* The tip of the root is covered by a little cap termed the *root-cap*, which can only be properly seen by the aid of a compound microscope.

the testa is occupied by the embryo. The embryo (fig. 2) has a small rod-like main axis, which is composed of the primary or main root, the *radicle* (*r*); the primary or main stem (*pl*); and a part of the axis, the *hypocotyl* (*hp*), which connects the root and stem. The tip of the young root lies close within the pore of the testa. No lateral roots occur on the radicle at this stage. The main body of the embryo is constituted of the two large fleshy leaves—the *cotyledons* (*cot*), which are attached to that

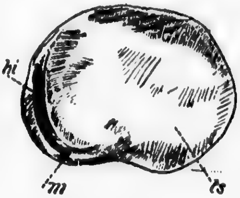


Fig. 1.—Seed of Bean.

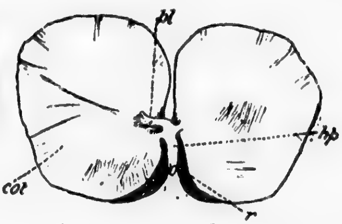


Fig. 2.—Embryo of Bean, with Cotyledons separated.

portion of the axis which is termed the hypocotyl. Lying hidden between the two cotyledons is the minute main stem, which terminates in a small bud. Thus, beginning at the root, the axis has no lateral members on its root-portion: above succeeds the hypocotyl* with two lateral cotyledons: still higher the axis represents the young main stem, and bears a few lateral commencements of leaves.

When the seed germinates, the various parts of the embryo emerge. The radicle elongates and becomes the primary root: it grows downwards and produces lateral roots which may branch in their turn. The little stem grows upwards and sends out from its sides, leaves, branches, and flowers; its branches may in turn bear, not only leaves, but also branches of their own. We thus see that the development of this flowering plant from its embryo consists in the elongation of its primary axis, and the production of lateral members on that axis. The parts possessed by a mature flowering plant, whether it be a large tree or a small herb, are all to be traced back to the primary axis.

* It is impossible to define exactly the limits of the hypocotyl unless the compound microscope be employed.

We can now define a root and a shoot. *A stem is an axis which bears lateral members—the leaves—dissimilar to itself. A stem together with its leaves constitutes a shoot.* A shoot terminates in a bud, and is usually the ascending portion of the plant: at least, parts of it are generally green. Lastly, the shoot bears the flowers. *A root is an axis which cannot produce leaves as lateral members of itself: consequently it does not terminate in a bud.** A root can only produce as lateral members branches like itself: as a rule it is a descending axis, and has no green colouring-matter.

THE ROOT.

If we fix a germinating bean (or pea) in a bottle containing air which is saturated with moisture, in the manner shown in fig. 3, when once the root has commenced to grow straight, we can follow the method of growth. To accomplish this, we make a number of transverse marks in Indian ink at equal and short distances along the root. After twenty-four hours' growth it will be found that the distance between the consecutive marks remains the same, excepting near the tip of the root, where the marks have become separated by longer intervals. This shows that the *root increases in length by elongation which only takes place in the region of its apex*: consequently, the youngest part of a root is that which is nearest its apex, whereas the oldest is that nearest its base.

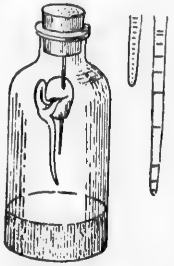


Fig. 3.

A short distance behind its apex (fig. 4 *rx*) the root has a broad encircling band of fine silky hairs—**root-hairs** (*rh*). As the root grows at its apex new root-hairs form constantly behind the tip, which, of course has been carried forward, so that the youngest root-hairs are those nearest the tip. These hairs live for a short time only, for they soon shrivel and peel off, and therefore they are found solely on the young and more terminal portions of a root.

A root may bear branches structurally similar to itself. These arise on the main root at points nearer to the root-

* It has a root-cap, which is not possessed by a stem.

apex than the last-formed lateral roots; so that the youngest and smallest of them are seen to be nearest to the tip of the main root (fig. 4). *The lateral roots* are therefore said to *arise in acropetal succession.* They do not appear at indifferent points; on the contrary, they emerge only on certain determined sides of the main root, so as to form regular ranks or rows along the length of the latter. For

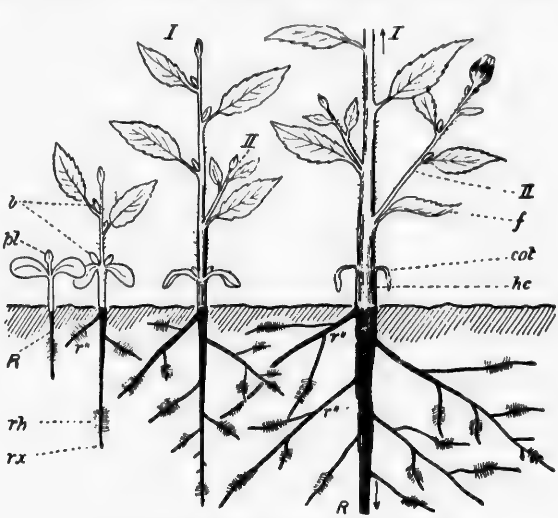


Fig. 4.—Development of a typical Dicotyledon.

example, the branches of a Wallflower-root form two rows, while those of the Creeping Buttercup-root are ranged in four rows.*

Adventitious Roots.—Lateral roots frequently arise on stems—for instance, on the creeping stems of the Strawberry (fig. 54), Creeping Buttercup, and Grasses; or on the underground parts of the stem of the Primrose or on "Cuttings." Inasmuch as these roots do not arise in the normal method—

* One important character concerning the origin of lateral roots is that they arise as internal growths, which push their way through the rind of the mother-root, and eventually reach the soil. They are said to be *endogenous* (arising within) in origin.

that is, as acropetal branches of another root — they are said to be *adventitious*. The difference between adventitious and normal lateral roots is well illustrated by considering the root-system of *Dicotyledons* and *Monocotyledons*. One of the general characteristics of a Dicotyledon is that its embryo in the seed has two cotyledons (*e.g.* Bean, Hazel, Oak). Frequently the root-system of Dicotyledons is formed after the manner described as occurring in the Bean, and well illustrated by fig. 4. The embryo of a Monocotyledon, on

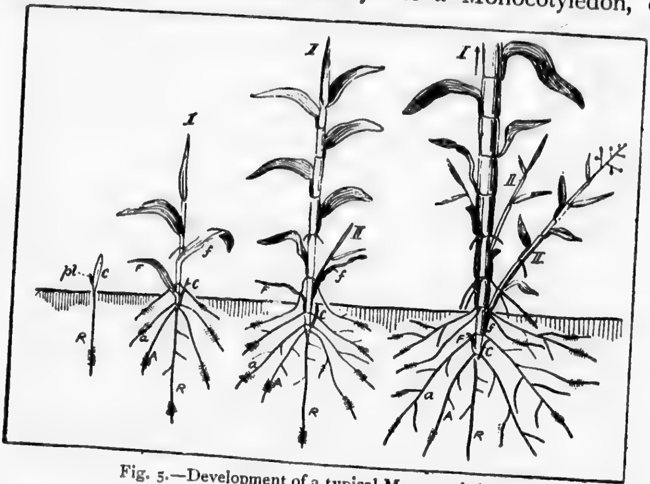


Fig. 5.—Development of a typical Monocotyledon.

the other hand, possesses only one cotyledon (*e.g.* Grasses, Lilies). Nearly always the root-system of a Monocotyledon develops in a manner entirely different from that pursued by the Bean. The young primary root (R) of the embryo grows for a short time only and produces at the most few lateral roots, eventually shrivelling up; but, sooner or later, lateral roots arise successively higher up the stem, first on the hypocotyl (A), then on the stem (*a*)—as is denoted in fig. 5. Consequently, in full-grown Monocotyledons practically the whole root-system is adventitious, and there is no main-root with branches. [In fig. 5 the roots have pulled the base of the shoot down into the soil.]

Shapes of Roots.—The roots may be thin and *fibrous*, or they may present various forms between this and a swollen or *tuberous* condition. The main root of the Carrot and Turnip, thickens and forms the swollen part which we eat. The Dahlia-plant produces a number of adventitious tuberous roots, which grow out from the base of the stem. As will be shown later on, tnese thick fleshy roots serve as reservoirs in which food is stored for future consumption by the plant.

Aerial Roots.—Some plants, like the Ivy, climb by means of adventitious roots which, in place of dipping down into the soil, adhere to the surface of a tree, wall, or rock. Roots above the surface of the soil are described as being *aerial* roots.

CHAPTER III

VEGETATIVE SHOOT—LEAVES

A SHOOT, in addition to possessing stems and leaves, may bear flowers. If we exclude the flowers, the remainder of the shoot may be spoken of as constituting the *vegetative shoot.* For the present, flowers will not be considered.

By making marks in Indian ink at equal distances along the stem, it is easily shown that a *stem grows in length only near its tip.* We can see this apical growth even more simply by observing the leaves constituting a growing bud. At first they are packed close together, but as the terminal part of the stem elongates they become separated by distinct intervals along the latter (figs. 6-11). Thus the youngest part of a single stem is nearest its tip, and the oldest part is that portion which is nearest its base.

If we pull the leaves from an actively growing bud of a Wallflower or Sunflower, we see that the external leaves of the bud are inserted lower down the stem than the internal leaves, and are larger than the latter; and the inmost leaves are the smallest, and are inserted nearest the actual end of the stem. Thus *leaves arise* only in the region of the apex of a stem and appear in acropetal succession*—that is, the youngest leaf is the one which is nearest the end of the stem. As the tip of the stem elongates, the leaves are, so to speak, left behind, and continue to grow till they attain their full size.

The leaves are attached laterally to the stem at certain points, which are termed **nodes.** These points of attachment are separated by portions of the stem—the **internodes**—which are devoid of leaves but connect the successive nodes (see figs. 4, 5).

* The leaves arise as external lumps on the side of the stem, and are thus *exogenous* in origin.

If the young part of a shoot be examined, it will be found that in the angle between the upper face of each leaf and the stem there is a bud (fig. 3 *b*). This angle is described as the *axil of the leaf.* Thus we may say that a *lateral bud* arises on a stem in the axil of every leaf.* These buds are the beginnings of the lateral shoots or branches, and can develop into shoots (fig. 3 ii.). We see, therefore, that lateral shoots arise in the axils of leaves—in other words, the *branching of the*

Figs. 6-11.—Development of bud of Hazel. (After Dennert.)

shoot is axillary. A shoot possessing an unbranched stem is described as *simple* (figs. 3, 4, the two left-hand drawings), but when the stem is branched, the shoot is said to be *compound* (figs. 3, 4, the right-hand drawing).

Normal buds, then, are terminal or axillary. A bud does not necessarily develop at once into a branch. It may remain in a resting or dormant condition, and is then described as a *resting-bud*, to distinguish it from an active bud.

* The bud appears as an external outgrowth of the stem ; it is *exogenous.*

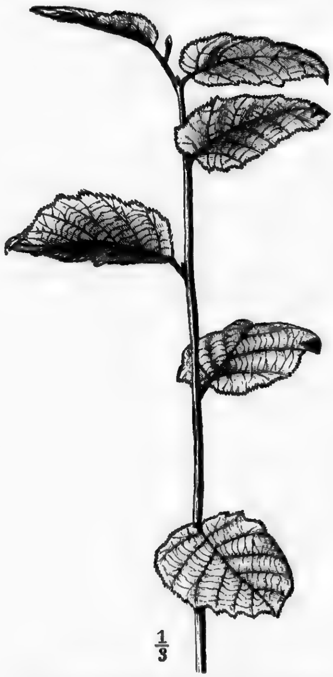
Adventitious Shoots.—Lateral shoots may arise on some flowering plants in places other than the axils of leaves. Such shoots are said to be *adventitious*. For instance, adventitious shoots may burst out from the roots of Poplars, Rose-trees, Hazels, and raise themselves above the surface of the soil. Again, adventitious shoots may spring from cut fragments of Dandelion-roots, or from Begonia-leaves pegged down to produce cuttings. When young branches shoot out from older parts of tree-trunks they are often axillary branches, and their appearance is merely due to the sudden activity of resting-buds which were formed years before. But in the case of Willow-trees from which the upper shoots have been lopped, many entirely new lateral buds arise on the upper part of the trunk. These grow out to form branches which are adventitious, because they are not due to the development of resting axillary buds. In all these cases of adventitious branching the shoots produced have stems and leaves, and therefore are shoots.

ARRANGEMENT OF THE LEAVES.

The leaves are attached to the nodes of the stem. On the stems of some plants (*e.g.* Buttercup, Wallflower) no two leaves are inserted at the same level on a simple stem—that is, there is only one leaf at each node. This leaf-arrangement is described as alternate or, better still, as *spiral* (*acyclic*). On other stems two or more leaves are attached at the same level and at the same node of a stem. The leaf-arrangement is then described as *whorled* (*cyclic*), and the collection of leaves at each node constitutes a *whorl*.

Whorled (Cyclic) Leaves.—In this leaf-arrangement the leaves at a single node are disposed in a very regular manner. They are inserted in such a way that the angular distance between each two adjacent leaves is the same. Thus, if there be two leaves at the node, they are inserted on the opposite sides of the stem (say the north and south sides), as in the Chickweed (fig. 43) and Dead Nettle; if there be four leaves, they are ranged like the four points of a compass (say N. S. E. W.); if there be three leaves at a node, each is separated from its neighbour

by one-third of the circumference. The relative disposition of the leaves at the different nodes is equally regular. In some cases the leaves at the successive nodes are exactly above one another *(superposed)*, so that there are just as many rows of leaves along the stem (longitudinal rows) as there are leaves at each node — for instance, there will be two longitudinal rows of leaves if there are two leaves at each node. But on other stems with whorled leaves, the leaves at one node stand above the gaps midway between the leaves of the next lower or next higher node; thus the leaves at the successive nodes exactly alternate with one another. Consequently, the leaves of every second node will stand above one another. In this case there will be exactly twice as many longitudinal rows of leaves as there are leaves at a single node. For example, the Dead Nettle, the Chickweed (fig. 43), have two leaves at each node, but those at the successive nodes alternate so that there are four rows along the stems.



$\frac{1}{3}$

Fig. 12.—Erect shoot of Hazel with $\frac{1}{3}$ leaf-arrangement. (After Dennert.)

Alternate or Spiral (Acyclic) Leaves.—When only one leaf stands at each node (fig. 12), the leaves are arranged in spirals, and not in circles or whorls. They form rows, and are ranged one above the other along the stem, as is the case with whorled leaves. Each leaf is separated from the one at the next node, either below or above it, not only by a variable distance along the stem, but also by a certain invariable angular distance round the stem. For example, on Grass-stems and most Hazel-stems

there is one leaf at each node, and each leaf is inserted on the side exactly opposite to that on which the leaf at the next node is attached; consequently we have to travel half-way round the stem (as well as go higher up) in order to reach the single leaf at the next higher node: the divergence, or angular distance, is described as being $\frac{1}{2}$. Again, in some Hazel-shoots (fig. 12) we have to travel one-third of the way round the stem in passing from one leaf to its predecessor or successor, and the divergence is said to be $\frac{1}{3}$. On the stems of the Oak, Red Currant, Pear, Poplar, Musk Rose, the divergence is $\frac{2}{5}$. The consequence of this constancy of the divergence between the leaves of the successive nodes of a stem is that the above-mentioned longitudinal rows of leaves are formed. In the Grasses and most Hazel-shoots with $\frac{1}{2}$ divergence, the leaves are ranged in two rows; in the Hazel-shoots with $\frac{1}{3}$ divergence, in three rows; on Pear-trees, etc., with $\frac{2}{5}$ divergence, in five rows. Thus in each case the denominator of the fraction denotes the number of longitudinal rows of leaves. And the numerator of the fraction represents the number of times it is necessary to travel round the stem in passing from one leaf on a stem to the next one vertically above it, at the same time touching all the leaves on the way thither. This gives us an easy method for determining the exact leaf-arrangement of a shoot. The commonest series are represented by the fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$. This series can be remembered with ease if we note that—

$$\frac{1+1}{2+3}=\frac{2}{5},\quad \frac{1+2}{3+5}=\frac{3}{8},\quad \frac{2+3}{5+8}=\frac{5}{13}.$$

Possibly the most simple way to understand the spiral method of arrangement of leaves is to look at the cone of a Pine-tree, or to remember that the leaves are distributed like the steps of a spiral staircase.

Diagrams to represent the leaf-arrangement.—We can denote the method of arrangement of the leaves on a stem by a plan or map, representing a side view of the surface of the stem unrolled into one plane, much as we show the surface of the spherical earth with its two hemispheres extended on a single flat map. Or, on the other hand, we can for a moment imagine that a shoot is like a large bud, and that we are looking down

on the top of the stem. We then draw a plan such as would be seen in cutting across a bud, the outermost leaves being those which are inserted at the lowest level, and the innermost leaves being those which are nearest the apex. Thus the diagram represents a sort of ground plan of the leaves and

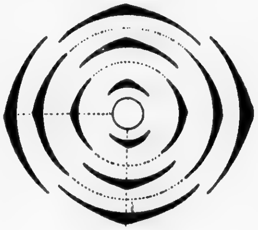


Fig. 13.

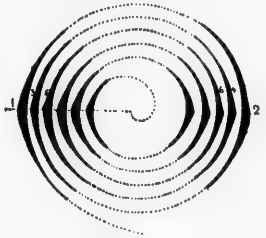


Fig. 14.

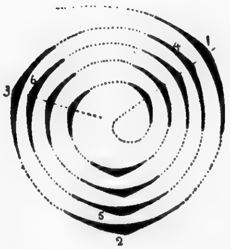


Fig. 15.

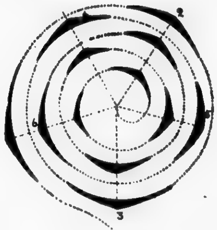


Fig. 16.

stem. Figs. 13, 14, 15, 16, will explain this second method of representing leaf-arrangement by diagrams. Fig. 13 represents whorled arrangement with two leaves in each whorl. Figs. 14, 15, 16, are diagrams of spirally-placed leaves with divergences of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{2}{5}$ respectively.

FOLIAGE-LEAVES.

A complete type of green leaf (fig. 17) consists of three parts: (i.) a flattened green *blade* or *lamina* (*sp*), which is the most conspicuous portion of the leaf; (ii.) a narrow, elongated *stalk* or *petiole* (*st*), which connects the blade with (iii.) the

expanded and flattened basal *sheath*, by which the leaf is attached to the stem. The sheath frequently bears two lateral outgrowths known as the *stipules* (*nb*).

(i.) THE SHEATH.

The **sheath** of a leaf may be well developed (*e.g.* Buttercup, Carrot, Cowparsnip), but frequently it is not distinguishable.

The **stipules** (fig. 17 *nb*) usually take the form of two flattened expansions of the leaf-sheath. They are parts of a single leaf. A leaf possessing stipules is described as *stipulate*; a leaf devoid of stipules is said to be *exstipulate*. Most frequently the stipules are small, and serve merely to protect the young growing leaves of a bud: in which case they drop off (*e.g.* Pear) or shrivel as they unfold from the bud. But the stipules may form good-sized green plates, which persist as long as the leaf-blade—*e.g.* Hawthorn (fig. 58 *n*), Pea (fig. 59 *n*), Violet. In the rhubarb-family, the two stipules of each leaf are replaced by a membranous pipe embracing that part of the stem which is near the leaf.

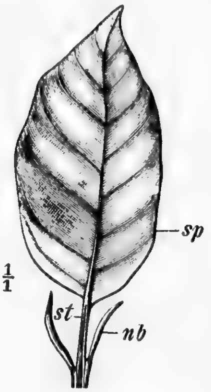


Fig. 17.—Leaf of Pear. (After Dennert.)

The leaf of a grass has a long tubular sheath which surrounds the stem, but is usually split down one side. The leaf possesses no stalk, so that the sheath is directly continuous with the blade. At the junction of the blade and sheath a small membranous plate—the *ligule*—stands out from the upper face of the leaf.

(ii.) STALK OR PETIOLE.

The stalk varies in length: in fact, it may be entirely absent, in which case the leaf is said to be *sessile*. Generally the stalk is attached to one end of the blade; rarely it is fixed to the lower face of the lamina, as in the garden *Tropæolum* (commonly, though incorrectly termed "Nasturtium").

(iii.) BLADE OR LAMINA.

The blades of foliage-leaves exhibit great diversities of form and size.

In **form** the lamina is usually a flat expanded plate or ribbon-like structure; but it exhibits all variations from the narrow needle of the Scotch Pine to the circular disk of *Tropæolum.* Its apex may be drawn out into a fine point or end bluntly, or even terminate in an indentation. The margin is even (*entire*) or uneven (toothed, saw-like, scalloped, etc.).

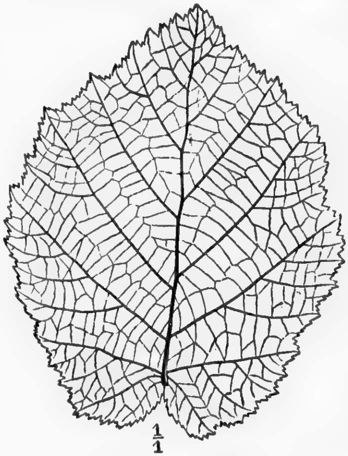


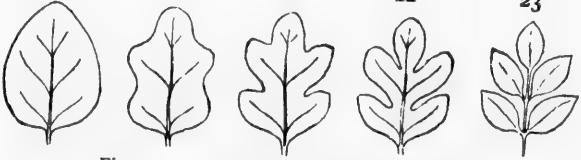
Fig. 18.—Venation of Hazel leaf. (After Dennert.)

Venation of the Lamina.—The substance of the blade is traversed by veins or nerves which frequently stand out more or less prominently. The arrangement of the veins may be grouped under two general headings—(i.) *parallel-veining*; (ii.) *net-like veining.* In **parallel-veined** leaves a number of veins, approximately equal in size, run side by side from the base of the lamina towards its tip. The veins are more or less parallel, and are connected by a limited number of smaller ones which join them at right angles. This type of venation is characteristic of Grasses, Lilies, and most other Monocotyledons. In **net-veined** leaves the finer veins are numerous, and form a complicated network (fig. 18). Most Dicotyledons have net-veined leaves. There are two sub-types of net-like venation—*pinnate* and *palmate* veining. A lamina which is *pinnately-veined* (feather-veined) has a single main vein—the mid-rib—which traverses the centre of the blade, running from the base towards the apex; this mid-rib gives off from its two sides smaller veins, which are arranged much like the pinnæ of a feather—*e.g.* Hazel (fig. 18), Pear, Primrose. A *palmately-veined* leaf, in place of possessing a

single mid-rib, has several large main veins which radiate in various directions from the base of the lamina towards its margins—*e.g.* Mallow.

Division of the Lamina.—The form of the lamina may be very simple, because all the spaces between the nerves are completely occupied by leaf-substance—*e.g.* Pear, Hazel. Often, however, incisions of considerable depth proceed from the margin, thus tending to complicate the form of the lamina and to split it into smaller sub-divisions. The degree to which the leaf is divided into smaller parts varies; for instance, the incisions are shallow in the Oak-leaf, but they are deep in the Buttercup-leaf. So long as the divisions do not reach the large nerves, the leaf is said to be **simple** (figs. 19-22, 24-26).

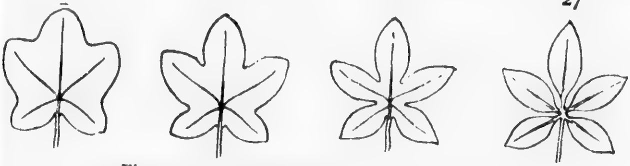
19 20 21 22 23



Figs. 19-23.—Division of pinnately-veined lamina.

When the lamina is divided by incisions which reach the main ribs there is no longer one single lamina, but there exist a number of distinct **leaflets**, and the leaf is described as **compound** (figs. 23, 27)—*e.g.* Rose, Pea (fig. 59), Clover.

24 25 26 27



Figs. 24-27.—Division of palmately-veined lamina.

Since a compound leaf consists of a number of distinct leaflets attached to a common stalk, it may be asked why should we not term it a branch and describe the leaflets as leaves. Several reasons may be given which serve to show that a compound leaf is a single leaf, and is not a branch.

(1) It does not arise in the axil of a leaf; on the contrary, it has a bud in its axil.

(2) Often it possesses two stipules at the base of its stalk —*e.g.* Rose, Pea (fig. 59 *n*).

(3) The leaflets do not necessarily arise in acropetal succession on the stalk of the compound leaf, neither does the latter terminate in a bud.

(4) The leaflets have no buds in their axils.

(5) A leaf is always lateral on an axis, but a leaflet may be terminal on a leaf-stalk—*e.g.* Rose.

When the leaflets are ranged along the sides of an elongated stalk, the leaf is said to be *pinnately-compound* (fig. 23)—*e.g.* Rose, Pea. On the other hand, when the leaflets spring from a single point at the summit of the stalk, the leaf is *digitate* (fig. 27)—*e.g.* Clover and Strawberry, with three leaflets (fig. 54), Horse-chestnut with about seven leaflets.

SIMPLIFIED LEAVES.

Some leaves are much simpler than the green foliage-leaves. They may be described as simplified leaves, and be arranged under four heads: *Scales*, *Cotyledons*, *Prophylls*, and *Bracts*. Usually they are not differentiated into sheath, stalk, and blade; frequently they represent merely parts of complete leaves.

SCALES.

Scales are small, simple leaves, usually with even (entire) margins. They possess little or no green colouring-matter, but are brownish or pale in colour. They are without stalks, and are attached to the stem by a relatively broad base. Scales occur upon parts of the stem which are above ground in the form of *bud-scales*, as in the Hazel and Oak, or quite apart from the buds, as in the Scotch Pine and Asparagus. But they are also present on subterranean stems, as in the Hyacinth, some Grasses, and Potato-tubers. Scales are therefore not defined by their position on the stem. A scale may represent the persistent base of a foliage-leaf, the upper portion of which has died away (as in some bulbs); in other cases the scales may be arranged in pairs, and are merely the stipules of leaves the blades of which never develop (as in the resting-buds of the Hazel); finally, some scales represent complete leaves (as in the bulb of a Lily).

COTYLEDONS.

One characteristic of an ordinary Dicotyledon, the Bean for example (fig. 2), is that the first two leaves produced by the embryo are inserted opposite to each other on the primary axis, and in form they differ from the subsequently produced foliage-leaves. These two leaves are known as the cotyledons. [Frequently the cotyledons are termed seed-leaves, because they are found inside the seed. But this expression seed-leaves is a bad one, because it seems to suggest that the seed bears cotyledons, whereas it is to the stem of the embryo inside the seed that these leaves belong.] Cotyledons are simple leaves, usually with margins devoid of any incisions; only very rarely do they possess stipules or definite sheaths, though occasionally they have distinct stalks. When the seed germinates the cotyledons may remain hidden in the soil, in which case they are not green in colour—*e.g.* Bean; but in other cases the cotyledons emerge (fig. 4) from the soil and become green—*e.g.* Beech, Sycamore, Mustard.

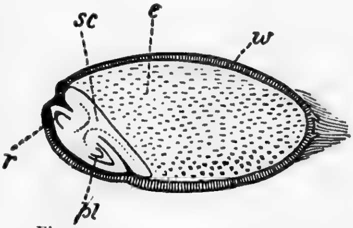


Fig. 28.—Vertical section through a grain of Wheat.

Opposed to the Dicotyledons are Monocotyledons, whose embryos possess only one cotyledon each. That is to say, the first leaf formed by the embryo is attached to the axis at a lower level than any other leaf. We may select the grain of the Wheat, for the purpose of examining a Monocotyledonous embryo.

Structure of a grain of Wheat (fig. 28).—As will be shown later, the grain of wheat is not a seed, but is a fruit with a single seed which occupies the whole of its cavity. The grain is smooth and convex on the one side, and deeply furrowed down the middle of the other side. Its main mass is formed by a substance termed the *endosperm* (*e*). The embryo is a small body placed at the bottom corner of this endosperm. Looking at the convex surface of the grain from the outside, there is a pale patch which indicates the position of the embryo. The latter is rather

complicated in form. The root-system consists of a short primary root (*r*), with a peculiar sheath, and several small lateral roots. The axis (*pl*) above the primary root bears a number of alternate sheathing-leaves. But one characteristic feature of the embryo of this and other grasses is that, attached to the hypocotyl, is a shield-like outgrowth—the *scutellum* (*sc*)—which separates the rest of the embryo from the endosperm. Botanists are not agreed as to which portion of the embryo represents the cotyledon. There are the three following views:—(1) The scutellum is the cotyledon. (2) The first sheathing-leaf and the scutellum together constitute the cotyledon. (3) The scutellum is merely a "subsidiary outgrowth" (emergence) of the hypocotyl: and the first sheathing-leaf represents the cotyledon.

Comparison between a Wheat-grain and a Bean-seed and their Germination.

GRAIN OF WHEAT.	BEAN-SEED.
1. Is a fruit which contains one seed. The wall is composed of the fruit-wall (pericarp), together with a very thin testa, which can be distinguished only with the help of a compound microscope.*	1. Is a seed. Its wall is formed by the thick testa only.
2. The space within the testa is occupied by endosperm and an embryo. The seed is consequently described as *endospermic*.	2. The space within the testa is occupied by an embryo only. There is no endosperm. The seed is said to be *non-endospermic*.
3. Embryo has one cotyledon.	3. Embryo has two cotyledons.
4. In germination.	4. In germination.
(*a*) The endosperm shrivels as the seedling develops: it is the food-supply of the embryo. The scutellum is the sucking-organ which absorbs nutriment for the benefit of the young plant.	(*a*) The cotyledons shrivel as the seedling develops. They contain the food-supply of the embryo.
(*b*) The main root forces its way through a peculiar root-sheath.	(*b*) The root has no peculiar root-sheath.
(*c*) The main root soon ceases to grow, and adventitious roots arise on the stem.	(*c*) The main root continues to develop and produces acropetal lateral roots.

* Recent investigations tend to show that, in reality, the testa is entirely destroyed before the grain is ripe.

PROPHYLLS OR PROPHYLLA.

In many Dicotyledons the first two, therefore the lowest two, leaves borne on each branch are small and scale-like. These two simple leaves—the *prophylls*—are inserted on opposite faces, the right and left sides of the branch. In Monocotyledons, on the other hand, there is only one of these simple leaves at the base of the branch, and it is inserted alone on the upper face of the branch—that is, on the face which is directed towards the main axis. We can easily remember these facts if we recollect that in Dicotyledons and Monocotyledons the leaves first formed on any stem are usually simplified. The first leaves of the primary stem are cotyledons; those of a lateral stem are prophylls. In Dicotyledons the primary axis has two cotyledons, the branch two prophylls; in Monocotyledons the primary axis possesses one cotyledon, the branch one prophyll.

BRACTS.

Often the leaves situated on that region of the stem which bears the flowers are simpler, and usually smaller, than the foliage-leaves of the same plant. These simplified leaves borne in the region of the flowering part of the shoot are termed bracts—*e.g.* Daisy, Bluebell, Hyacinth. In the majority of cases, bracts are small, without stalks, and attached by broad bases; their margins tend to be entire. Bracts may assume the form of small scales, as, for example, in the case of the *glumes* of grasses (fig. 231), the chaffy bracts of the Sunflower (fig. 208). Exceptionally large sheathing bracts, which enclose the whole inflorescence, occur in the *Arum*, also in the Snowdrop, and are termed *Spathes* (fig. 226).

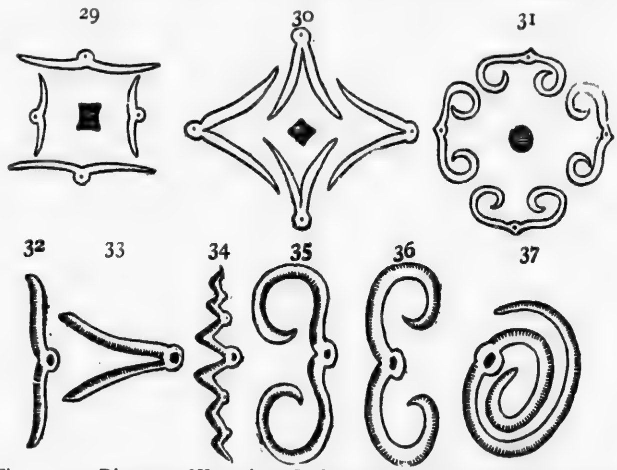
CONSIDERATIONS WITH REGARD TO SCALES, PROPHYLLS, COTYLEDONS, AND BRACTS.

The remarks in the few preceding paragraphs render it obvious that scales are defined by their form, and are not confined to any particular regions of the shoot; but the other three varieties of simplified leaves occupy certain definite positions on the plant, and are defined as well by their position as by their simple forms. That they all represent true leaves is proved by the following considerations:—(i.) They are lateral appendages of the stem arranged like foliage-leaves,

and have buds in their axils. Often it is an easy matter to cause these axillary buds to develop into branches; for instance, if we nip off the stem of a Scarlet Runner just above the points of insertion of the cotyledons, the buds in the axils of the latter will shoot out and become branches. (ii.) In many plants transitions from foliage-leaves to bracts (*e.g.* Rose, Christmas Rose), or to scales (*e.g.* buds of the Horse-chestnuts), or even to cotyledons, occur. (iii.) It is possible to cause foliage-leaves to appear in place of scales; for example, some stems (*e.g.* Potato-tubers), which are normally subterranean, when caused to develop above ground, produce foliage-leaves instead of small scales.

BUDS.

Æstivation is the term applied to denote the arrangement of the different leaves of a bud with reference to one another. In the bud the leaves forming a single whorl or spiral may not be in contact, in which case the æstivation is said to be



Figs. 29-37.—Diagrams of Vernation. In figs. 32-37 the shaded face of leaf is the upper face. The leaves are transversely cut.

open. When their edges just touch, without overlapping, the æstivation is *valvate.* Finally, when the leaves overlap the æstivation is *imbricate.*

Vernation is the term applied to denote the manner in which each single leaf is packed in the bud. Each leaf may be flat or *plane* (figs. 29, 32). In some cases the leaf is *folded* in various ways along the courses of the chief veins. The two halves of the lamina may be simply *folded* together along the mid-rib, like two pages of a book (figs. 30, 33); or there may be a number of folds (fig. 34) along several of the large veins, especially in leaves with parallel venation (*e.g.* many grasses) and with palmate venation, so that the young leaf reminds us of a closed fan or a pleated garment. In other instances the leaf is *rolled* from side to side. Each half of the lamina may be rolled towards the middle line of the upper face of the leaf, as in the Pear (figs. 31, 35, 38), or towards the middle line of the lower face (fig. 36). Occasionally the whole lamina is rolled sideways in one direction (fig. 37). Finally, the leaf may be *coiled* from the apex of the leaf towards the base, like a watch-spring.

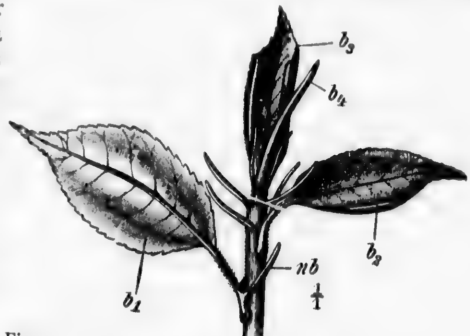


Fig. 38.—Unrolling of leaves (b_1, b_2, b_3, b_4) of bud of Pear. *nb*=stipules. (After Dennert.)

CHAPTER IV

STEM AND SHOOT

DEFINITE AND INDEFINITE GROWTH IN LENGTH.

An ordinary stem of a flowering plant elongates solely by means of growth at its apex. The apex may continue to grow for a long period, so that the stem will bear many leaves and lateral buds; such a stem is said to be unlimited or *indefinite* in its growth. On the other hand, the apex may soon cease to grow, so that the stem attains only a limited or *definite* length. The Scotch Pine (fig. 62) has shoots which exhibit both these methods of growth. The main trunk and conspicuous branches are of indefinite growth, and bear leaves only in the form of scales; they constitute the so-called *long-shoots*. In the axils of most of the scales on the long-shoots there arise lateral *dwarf-shoots* (fig. 39). Each dwarf-shoot consists of a short definite stem, bearing just below its apex two needle-like green foliage-leaves (*f*), and below these a number of scale-leaves (*s*): the apex (*a*) of the stem lies between the two needles (fig. 40).

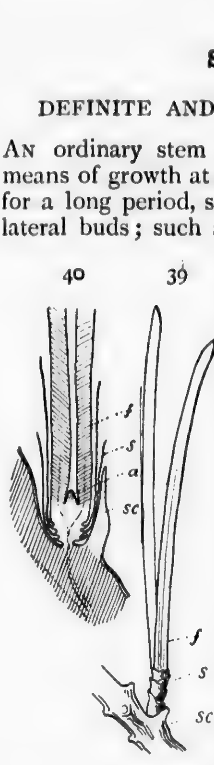


Fig. 39.—A dwarf-shoot of Pine, in axil of scale (*sc*).
Fig. 40.—Vertical section of ditto.

Stem or axes of different orders (fig. 41).—A stem is an axis bearing leaves. This definition gives us no means of stating simply whether the stem be a main stem or a lateral one: hence it is advisable to adopt some terms by which we can explain to which stem we are alluding. The main stem (I.) is described as an *axis* (stem) *of the first order*, or as the *primary axis*. A lateral axis (II.)

arising on the primary stem is termed an *axis of the second order*, or a *secondary axis*. A lateral axis (III.) arising on a secondary axis is an *axis of the third order*, or a tertiary axis; and so on.

Fig. 41.

Formation of false-stems or sympodia.—A simple stem being unbranched obviously must be an axis of the first, second, or third, etc. order. Frequently, branched stems are formed which, at first sight, seem to be simple; this is particularly the case in plants possessing stems of definite growth.

The formation of such a falsely simple stem—a *sympodium*—may be illustrated by considering the growth of a grass which lives for several years and possesses a subterranean shoot-system. Following out the development of a horizontal under-ground stem of a grass, it will be seen that the end of the stem eventually bends out of the soil, becomes erect, and terminates in an inflorescence. But the base of the erect portion of this stem produces a bud which grows for a certain distance in the soil and presents the false appearance of being a continuation of the original stem. This lateral axis in turn bends out of the soil and produces flowers as did the first stem. A third axis arises on the second lateral axis and behaves in exactly the same manner as its predecessors. Fig. 42 is a diagram of a grass which is supposed to be flowering at the present time (in summer). A year ago, axis I. bore flowers (which are now invisible), and it also possessed a leafy branch (II.), the

Fig. 42.—Method of growth of a perennial Grass.

termination of which had emerged from the soil. This year, axis II. is flowering, and its branch (axis III.) has just emerged from the soil with its foliage-leaves, and will next year terminate in an inflorescence. Axis III. has a branch of its own, (axis IV.), which next year will push above the soil and assume the present condition of axis III., and in the second year after will flower. It will thus be seen that the creeping subterranean axis is not a true axis, but is composed of the subterranean portions of axes I., II., III., IV., apparently strung together end to end. Each true axis is roughly L-shaped, and the sympodium is made up of the bases of successive Ls.

Some of our trees, especially Willows, Elms, Limes, Beeches, have sympodial branches, which are produced in a slightly different manner. In these trees the terminal buds of the branches often die in autumn, and in the following year the highest axillary bud on each shoot grows out and behaves as if it were the true terminal bud. Again, in the Hazel occasionally an axillary inflorescence arises close to the apex of a shoot, and as it develops it causes the terminal bud to die and drop off (see fig. 131).

ARRANGEMENT OF BRANCHES.

So far as we have considered a flowering plant, we have found that every leaf has a bud in its axil. An axillary bud is simply a small lateral shoot which may develop into a branch. If all the axillary buds of a plant were to grow out, the branches would be arranged on exactly the same plan as the leaves (*i.e.* in whorls or in spirals). But many leaves have no branches in their axils; this is due to the fact that, though the buds are present they remain inactive. Thus we may range buds under two heads: those which are active or *growing*, and those which are inactive or *resting*. The disposition of branches on a stem depends, therefore, not only on the arrangement of the leaves, but also upon the behaviour of the axillary buds.

Racemose branching.—When a stem grows strongly and produces a considerable number of branches which remain smaller than itself, the branching is said to be *racemose* (fig. 4).

Cymose branching.—When a stem grows only for a limited time and produces only a few branches which subsequently develop more vigorously than the stem which bears them, the branching is said to be *cymose* (fig. 43).

HERBACEOUS AND WOODY STEMS.

There is considerable variety in the toughness, consistence, and longevity of stems. A stem may be soft and relatively short-lived: in which case it is said to be herbaceous. A plant, the above-ground stems of which are invariably herbaceous, is described as a *herb.* With the exception of our herbaceous climbers (*e.g.* *Convolvulus*) nearly all British herbs are plants of low stature, like the Buttercup and Primrose. Opposed to herbs are trees and shrubs whose stems are hard and woody, and capable of existing for considerable periods. A *tree* is distinguishable from a shrub by its possession of a distinct main-trunk which bears branches. A *shrub* is usually smaller than a tree, and, in place of having a main-trunk, possesses several woody branches which spring from a common point: *e.g.* Blackberry.

SECONDARY INCREASE IN THICKNESS OF STEMS.

The old part of the stem of a grass, a palm, or almost any Monocotyledon, is no thicker than the young part near the apex. The stem of the Mono-

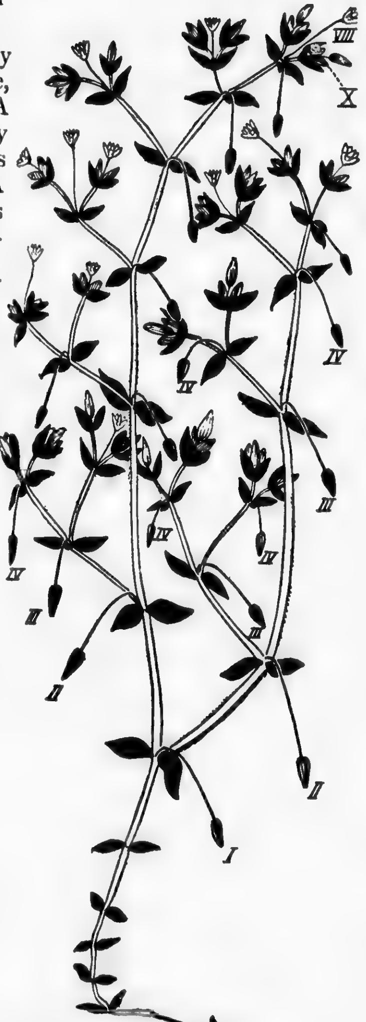


Fig. 43.—Cymose branching of Chickweed (*Stellaria media*). The main stem (axis I.) ends in a flower I., which is bent down in the figure. On the main stem there arise two branches (axes II.), each ending in a flower II. (which is bent down in the illustration), and having two branches (axes III.), which terminate in flowers III.; and so on.

cotyledon cannot increase in thickness when it has once ceased to elongate. But the reverse is the case with Dicotyledonous trees. An old part of an Oak stem is much thicker than a young part near the apex: the older the stem the thicker it is. After the stem of a Dicotyledon has ceased to elongate it may be able to grow in thickness. If we examine the trunk of an oak-tree which has been cross-cut, we note the bark lying outside the wood. In the centre of the trunk there is a dark patch of *heart-wood*, which is surrounded

44 45 46 47

Figs. 44-47.—Cross-sections of stems showing annual thickening rings of wood. Fig. 44 is one year old. Fig. 45 is two years old. Fig. 46 is three years old. Fig. 47 is five years old, and shows the bark peeling off. 1 denotes wood formed in the first year; 2, the wood formed in the second year; and so on.

by the lighter-coloured *splint-wood*. Still looking at the cross-section of the trunk, we note that there are a number of ring-like markings ranged round the centre. We find that in a two-year-old stem there are two rings, in a three-year-old stem three rings; in fact, that the number of rings corresponds with the number of years of growth of that portion of the stem. For this reason the rings are termed *annual rings*. Each ring denotes one year's growth in the thickness of the stem. There are also numberless radial lines which are the *medullary rays*. The knots met with on cutting across timber are the remains of portions of branches, which have been buried in the wood as the stem thickened.

SUBTERRANEAN SHOOTS.

A stem may protrude into the air and be *sub-aerial*; or live under water and be *submerged*; or lie buried in the soil and be *subterranean*.

In the case of many plants only a part of the shoot is raised

out of the soil, the remaining portion being underground. The subterranean stems are distinguishable from roots (i.) by their possession of leaves and buds; (ii.) by reason of their continuity with axes which bear foliage-leaves, or by their aris-

Fig. 48.—Base of Potato-plant, showing tubers. (After Baillon.)

ing in the axils of leaves. There are four common types of subterranean shoots—*rhizomes*, *tubers*, *corms*, and *bulbs*.

A **rhizome** is a more or less elongated subterranean shoot which frequently extends in a horizontal direction in the soil. Its stem often bears scales which are membranous, and it usually gives off adventitious roots. Nearly all rhizomes are sympodia, as, for instance, in Grasses, in *Iris*, and in the Dandelion, their

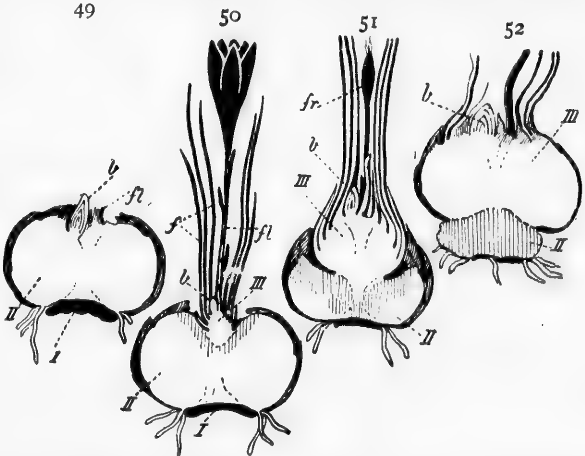
subterranean portions being formed of the persistent bases of successive lateral axes, whose sub-aerial portions produce flowers and then die. The development of the rhizome of a grass as given on page 25 illustrates the mode of formation of the underground sympodia. The Woodsorrel (*Oxalis acetosella*) affords an exception to this rule; the axis of its rhizome is a single true axis which does not emerge from the soil; the shoots (flowering axes) which protrude into the air are axillary branches of this horizontal subterranean stem, which bears scale-leaves and compound foliage-leaves.

A **tuber** is a subterranean shoot, which consists of a short swollen stem bearing small membranous scales. The tuber gives off adventitious roots. The Potato-tuber is a tuberous stem; its "eyes" are buds which arise in the axils of minute scale-leaves. The difference between these tubers and tuberous roots is well brought out by a comparison between the Dahlia and the Potato-plant. The subterranean tuberous bodies of the Dahlia arise on the base of the stem, in positions which bear no relation to the leaves on that stem; they possess no leaves. (They arise endogenously, and their tips are clothed with root-caps.) In fact, they are adventitious roots. The tubers of the Potato-plant are thickened portions of lateral stems which definitely arise in the axils of leaves (fig. 48) at the base of the main stem of the plant; furthermore, they bear scales, and when caused to develop above the soil they produce foliage-leaves. (They are exogenous in origin.)

A **corm** is a subterranean shoot which consists of a short thickened stem more or less invested by membranous scales. The corm has relatively larger scales than a tuber.

Life-History of the Garden-Crocus (*Crocus vernus*) (figs. 49-52).—Each corm of this plant is the swollen basal part of an axis which terminates in a flower; but the corm does not develop on that axis until after the latter has blossomed. Examining a plant in spring (fig. 50), shortly after the flower has withered (or even whilst it is flowering), we note that there is a yellowish wrinkled corm, on the upper face of which is either the stump or the scar of the flowering axis of the preceding year. This is encased in brown scales, and represents an axis which we will term "axis II." On its upper face there is also inserted the axis which terminates in the recently withered flower (*fl*). This is really a lateral branch of "axis II.," and

may be termed "axis III." The flowering stem—axis III.—has below its terminal flower several bracts, beneath which are a limited number of long, narrow foliage-leaves (*f*) with broad basal sheaths; and still lower down the stem a few sheathing scales succeed. Already the base of this flowering axis III. is swelling, above the insertion of its lowest scales, to form a new corm, so that one slender internode intervenes between the



Figs. 49-52.—Yearly history of Garden Crocus. Fig. 49.—Plant resting in winter. Fig. 50.—Plant flowering. Fig. 51.—Plant fruiting. Fig. 52.—Plant preparing for winter-rest after fruiting.

older corm and the younger one. The new corm is growing at the expense of the food manufactured by the foliage-leaves, and also the nutriment which is being supplied by the mother-corm (axis II.). The latter is gradually shrivelling up and parting with its contents. In the axil of the uppermost foliage-leaf of the flowering stem (axis III.) is a bud (*b*), which will next year develop into a flowering axis (axis IV.) and will produce a new basal corm. Thus each year a new corm arises above the preceding one, and represents the uppermost axillary branch of its predecessor, by which it is fed. Therefore, axis II. is a branch of the shrivelled axis I., which is to be seen in the resting corm during winter (fig. 49). Occasionally several axillary buds develop on an axis, and each produces a

corm, so that when the mother-corm shrivels up, the several new corms become separate and form distinct individuals. The adventitious roots are given off from the old corm, and serve to supply water and nutriment to the flowering axis and to the developing corm.

A **bulb** is a subterranean shoot which consists of a short bun-like stem with fleshy scales. The main mass of the bulb is made up of leaf-structures. In the case of the bulb of the Tulip the scales are complete scale-leaves, and the plant has foliage-leaves in addition. But the scales of some bulbs are not complete leaves, they are merely the persistent basal portions of green leaves, the blades of which have decayed. For instance, the single stem of a Snowdrop, which terminates in an inflorescence, bears two long, narrow foliage-leaves, which are attached to its base. As the season advances, the green upper portions of these two leaves decay and their bases thicken to form two fleshy scales. The bulb of a Snowdrop consequently consists mainly of two thick scales borne on a short axis. In the axil of one of the scales is a bud which, in the following year, will develop to form a new flowering axis. As the latter grows, the two scales will shrivel as they pass their contents on to the growing stem. This new flowering shoot will subsequently behave just like its predecessor, and the brown shrivelled remains of the two old scales will be

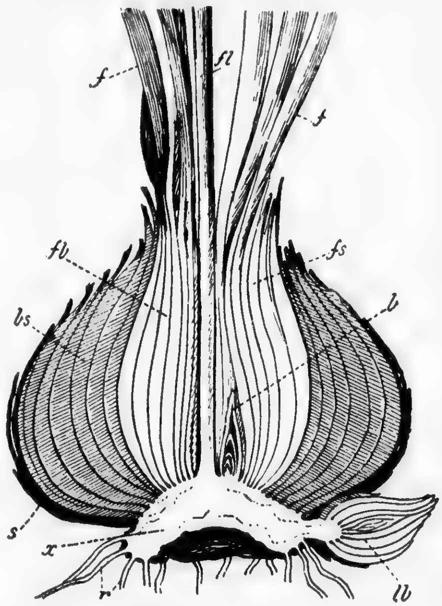


Fig. 53. — Vertical section of bulb of Hyacinth: *x* is the flattened axis; *fl* is the inflorescence axis; *lb* is an additional lateral bud forming a small bulb.

seen outside the daughter-bulb. The Hyacinth-bulb (fig. 53) has scales of both sorts; there are true scale-leaves (*fs*), as well as scales (*fb*) which are the persistent basal parts of green leaves (*f*). In all these bulbs each new one (*b*) arises as an axillary bud on the bulb of the previous year. The older bulb-scales shrivel and give their contents to the younger parts. The lower surface of the stem of the bulb gives off adventitious roots.

SUB-AERIAL STEMS—DIRECTION OF GROWTH.

Occasionally the foliage-bearing part of a stem which is above ground is so short that the leaves form a tuft, apparently

Fig. 54.—Strawberry plant, showing runners. (From Dennert.)

springing from the ground—*e.g.* Dandelion and Daisy. The leaves are then said to be *radical* in position.

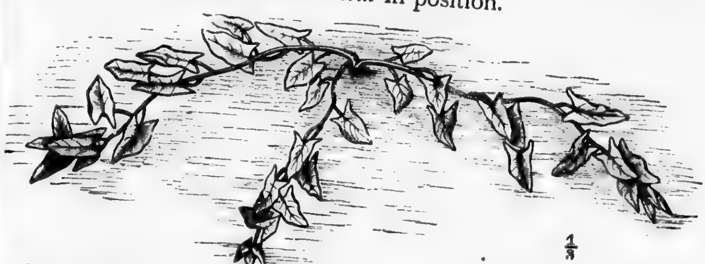


Fig. 55.—Plant of *Convolvulus arvensis*, which is prostrate because it has met with no support up which it can climb. (After Dennert.)

Fig. 56. Twining *Convolvulus arvensis*. (After Dennert.)

As a rule the sub-aerial foliaged axis is of appreciable length. It may be *erect*, as in the Sunflower, or it may be extended horizontally over the surface of the soil (fig. 55). The "runners" of the Strawberry are creeping stems which have long internodes and produce tuft-like shoots and adventitious roots at the nodes (fig. 54). Between erect and prostrate stems various transitional stages occur.

CLIMBING PLANTS.

A prostrate trailing plant usually has long, slender stems which call in the assistance of the soil to bear the weight of the branches and leaves. Another group of plants—climbers—also require external support; they rise above the soil and lean against, or fix themselves to, other plants, rocks, walls, etc. Like the majority of prostrate plants, climbers have slender stems, usually with long internodes—in fact, a climbing plant may become prostrate if it finds no external object up which it can climb (fig. 55). Climbing plants may be ranged for the present under four heads: root-climbers, twiners, irritable-climbers, scramblers.

(i.) **Root-Climbers.** — The Ivy ascends by means of numerous aerial adventitious roots, which are given off by the stem and serve to fix it to the supporting object.

(ii.) **Twining Plants** are those possessing stems which twist round the supporting objects. In most cases the twining stem twines in a definite direction; for example, the Bindweed (*Convolvulus*) climbs in a left-handed spiral, as is shown in fig. 56; whereas the stems of the Hop and Honeysuckle ascend in a right-handed spiral. The differences between these twiners and the following class of climbing plants are not easy to explain in this elementary work, but it may be generally stated

that twining plants can only twine round supports which are erect or nearly so.

Fig. 57.—*Bryonia dioica* (left side of figure) climbing up a Bramble (right side of figure) by means of a tendril. (After Dennert.)

(iii.) **Tendril-Climbers and Irritable Climbers.**—Some plants (*e.g.* Pea and Vine) possess peculiar slender climbing organs

termed *tendrils* (figs. 57, 59). A tendril is a simple or branched string-like irritable* structure which is capable of coiling round, or fixing itself to, suitable objects. Tendrils and other irritable climbing organs can embrace slender supports which are horizontal in position. The leaf-stalks of the garden *Tropæolum* and of *Clematis*, also the finely-divided leaves of the Fumitory, act like tendrils and coil round slender stems.

(iv.) **Scramblers** do not adopt any of the methods above mentioned; they merely lean against or scramble over other plants. Some clamber up by the aid of hooks or prickles, as in the case of *Galium* (Cleavers) and *Rubus* (Brambles).

SUBSIDIARY OUTGROWTHS (HAIRS, ETC.).

So far we have mentioned roots, stems, and leaves, but have given no account or explanation of the hairs, hooks, and prickles scattered over various parts of plants. We have learnt that roots, stems, and leaves all arise, and are arranged, in accordance with certain definite laws. Furthermore, they are recognisable by their structure. The hairs, prickles, etc., which are irregularly arranged over the plant, cannot be regarded as being roots, stems, or leaves, because they do not occupy the definite positions assigned to these members. In particular, hairs are found on roots, stems, and leaves: prickles occur on leaves and stems; these structures are not axillary in position, nor do they have buds in their axils. We therefore require a term to include all outgrowths which are neither roots, stems, nor leaves, but are, more or less, irregularly disposed on those members. We may term these structures "*subsidiary outgrowths.*" [In the majority of text-books "subsidiary outgrowths" are referred to under the heading of "hairs and emergences"; but it is impossible to give the complete definition of a hair or an emergence without assuming a knowledge of microscopical botany.]

METAMORPHOSED SHOOTS.

Stems and leaves assume many different forms, and they may present appearances so changed, or metamorphosed, as to

* See the section on Physiology.

render it a matter of difficulty to recognise them as such. For instance, stems may assume the appearance of leaves; stems, leaves, or parts of them, may appear in the form of spines or of tendrils. It is mainly by the study of their arrangement that we can recognise as such these metamorphosed stems and leaves, and can distinguish them from "subsidiary outgrowths."

SPINES, THORNS, AND PRICKLES.

Many plants are armed with sharp-pointed woody structures, which may represent stems, leaves, or subsidiary outgrowths.

(i.) **Stem-spines.**—The spines of the Hawthorn (fig. 58) occupy the position of branches, for they stand in the axils of leaves; they bear small leaves, which soon fall off. These spines, therefore, represent stems of definite growth, whose growing points become hard and woody. Certain branches of the Pear-tree often end in spines, which, therefore, are metamorphosed stems.

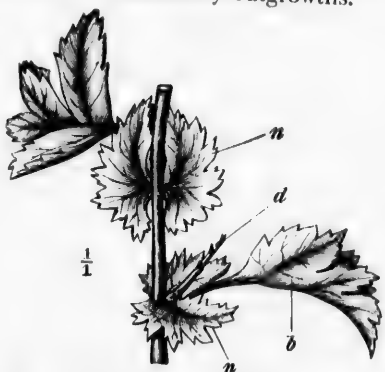


Fig. 58.—Shoot of Hawthorn with a stem-spine (*d*) in the axil of a leaf. *n* represents stipules *b* denotes the lamina. (After Dennert.)

(ii.) **Leaf-spines.**—The leaves of Thistles and of the Holly have spinose outgrowths, which are obviously portions of the lamina. The Barberry-plant has branched spines, in whose axils branches arise: hence they are metamorphosed leaves. This view is confirmed by the fact that on a stem of the Barberry it is often possible to see all the transition stages between the green leaves and the branched spines. Each foliage-leaf of many Acacias has two spines occupying the position of the two stipules: therefore the spines are metamorphosed stipules.

The Common Furze or Gorse (*Ulex europæa*) has thorns, some of which possess axillary buds, and others of which terminate stems. Thus in this plant both leaves and stems have changed to form spines.

(iii.) **Spines, Prickles** which are **subsidiary outgrowths.**—The leaves and stems of Brambles (fig. 57) and of many Roses have prickles, woody hooks, or long spines scattered over them in indefinite positions. These structures, therefore, represent "subsidiary outgrowths."

TENDRILS.

(i.) **Leaf-tendrils.**—The leaves of the Pea (fig. 59) are pinnately-compound, and have large green stipules. The positions which should be occupied by the terminal leaflet and the two or more pairs of uppermost leaflets are taken by a single terminal tendril and two or more pairs of lateral ones. The tendrils of the Pea, therefore, represent metamorphosed leaflets.

Fig. 59.—Compound leaf of Garden Pea. *n*=stipules; *fbl*=leaflets; *br*=leaflets converted into tendrils. In this leaf the terminal tendril is wanting. (After Dennert.)

(ii.) **Stem-tendrils.**—The tendrils of the Passion-flower arise in the axils of leaves, and are therefore modified branches.

The tendrils of *Bryonia dioica* (fig. 57) are not so easily understood. They probably represent metamorphosed shoots, the leaves of which are absent.

LEAF-LIKE STEMS (*CLADODES*).

The green feathery part of an Asparagus-shoot consists of numerous green stems arising in the axils of minute colourless scales. The Butcher's Broom (*Ruscus aculeatus*) has short, flattened, leaf-like branches, each terminating in a sharp point. That these leaf-like members are lateral stems is evident from the fact that they bear leaves and flowers, and arise in the axils of the true leaves, which are inconspicuous scales.

CHAPTER V

THE LIFE-HISTORY OF FLOWERING PLANTS

WHILST flowering plants display a considerable uniformity in their general conduct, they vary amongst themselves in regard to details, such as the duration of their existence, and their precise behaviour during life. Even a single individual does not acquit itself in a constant and uniform manner throughout life. Its variations in conduct are largely associated with corresponding changes of season. For example, flowering plants in Britain, for the most part, grow actively during summer, but at the onset of winter they tend to enter into a passive or resting condition, during which growth is practically at a standstill. We can therefore regard the life of a plant as made up of actively vegetating or growing periods and resting periods. Though the British flowering plants commence and conclude their phases of active growth at different times of the year, yet for the vast majority of them the period from spring to autumn is the vegetative season, whilst winter is the resting season.

FREQUENCY OF FLOWERING AND DURATION OF LIFE.

Some plants blossom only once in their lives, and die as soon as their seeds have ripened; they are described as being *monocarpic*. Opposed to these are others which flower repeatedly and produce crops of flowers year after year: these are termed *polycarpic* plants.

Monocarpic plants may be further sub-divided into three groups, according to the age at which they produce their single crop of flowers. A plant which germinates, produces its flowers and fruits, and then dies, all in one vegetative season, is termed an *annual*—*e.g.* Wheat and Field Poppy. Some annuals complete this cycle of life within a few weeks, so that in one vegetative season several generations of individuals may be derived from one plant: these are small herbs, and are

distinguished by the name of *ephemerals—e.g.* Chickweed and Shepherd's Purse. Annuals proper can produce only one generation in a single vegetative season, because their life extends over several months. A plant which germinates and vegetates in its first active season, and blossoms and dies in its second year, is described as a *biennial—e.g.* Turnip. Finally, a plant which is capable of existing for several years is termed a *perennial*; and if it can blossom only once it is described as a *monocarpic perennial—e.g.* some Palms.

Polycarpic plants are all perennials. They vegetate and produce flowers and seeds season after season—*e.g.* Dandelion, British trees and shrubs.

It is more important to lay stress upon the number of times a plant can flower than to consider whether the plant be annual, biennial, or perennial; for the distinctions amongst these latter are largely arbitrary. For instance, many plants which are described as annuals can germinate in autumn, rest during the winter, and flower in the following spring—in fact, they act as biennials. Again, if by artificial or natural means the formation of fruits or flowers on an annual be prevented, the annual may live for years—in fact, it becomes a perennial: *e.g.* Mignonette and Annual Meadow-Grass. The Daisy, which is perennial in England, is annual at St Petersburg.

METHODS OF RESTING.

Ephemerals and annuals rest during the winter in the form of seeds. In most cases their vegetative organs are dead. But some annuals, when sown in autumn, can pass the winter in the form of young green plants.

Biennials and perennials retain only certain portions of their vegetative organs at the resting season. There are certain broad distinctions between the modes of resting of herbs and of woody plants belonging to these classes.

Resting condition of perennial herbs.—A number of perennial herbs retain their sub-aerial stems and green leaves during the winter; amongst these are many Grasses, and Wallflowers in gardens. But in the majority of perennial herbs the parts of the shoot which are above the soil die down, and only subterranean portions of the plant continue to exist at the resting season. Herbaceous perennials may rest in the form of sub-

terranean shoots:—rhizomes (*e.g.* Dandelion), tubers (*e.g.* Potato), bulbs (*e.g.* Hyacinth), corms (*e.g.* Crocus)—or in the form of roots. In the following vegetative season these underground parts send up shoots which force their way out of the soil and bear foliage-leaves and flowers.

Resting Condition of Trees and Shrubs.—In perennial woody plants a considerable part of the sub-aerial shoot persists during winter. The woody stems and the buds, usually covered with scales, represent the resting tree or shrub. Some of these woody plants shed their foliage-leaves before winter sets in—*e.g.* Hazel and Larch—and are described as *deciduous.* Others retain their green leaves during that season, and are termed *evergreens*—*e.g.* Pines, Firs, Yew, Ivy, Box, and Heaths. But even the evergreens do not retain the whole of their leaves for an indefinite period: each year the oldest leaves drop off, so that a green leaf lives only for a few years.

METHODS OF VEGETATIVE MULTIPLICATION.

Many flowering plants are able to increase in number without the intervention of seed-production. Portions of the plant become separated from the mother-plant by the decay of parts which connect them with the latter. These disconnected younger sections, having produced roots of their own, become distinct individuals. For example, the long internodes of the Strawberry-runners may decay and the tufted shoots at the nodes consequently become separate plants. Again, the decay of those parts of the stem which connect the tubers of a Potato with the mother-plant has the same result, for each tuber can produce a new Potato-plant. Frequently in bulbous plants young bulbs arise in the axils of several scales, or a number of little bulbs may appear side by side in the axil of one scale; in either case, the death of the old bulb leads to separation of the daughter-bulbs. The horizontal lateral roots of the Hazel, Poplar, and Rose, give off erect adventitious shoots—the so-called *suckers*—which force their way out of the soil and assume the appearance of ordinary shoots. The suckers may become separate individuals by the decay of the connecting root and the production of adventitious roots at the bases of their own stems. "Cuttings," as taken by gardeners, also illustrate the vegetative multiplication of plants.

ORDER OF SUCCESSION OF EVENTS.

After germination, a plant at first confines itself to vegetative growth and finally bears flowers and fruits. Even in each vegetative season a shoot tends to adopt the same course of action—first its vegetative buds flush, the foliage-leaves unfold, and the stems elongate, and eventually the flowers open. In some plants this order of succession in one single vegetative season is changed: the flowers may appear before the leaves unfold, as is the case with the Hazel, Almond, and some Cherries.

CHAPTER VI

THE FLOWER

FLOWER OF A BUTTERCUP (FIGURES 60, 61).

IF we examine the flower of a Buttercup, we note that it consists of four kinds of members inserted laterally upon a central axis. This is seen with particular clearness if we cut the flower down the centre (fig. 61).

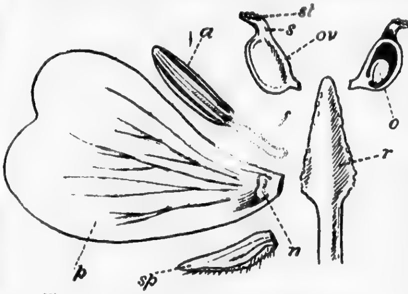


Fig. 60.—Dissected flower of Buttercup.

The portion of the axis which bears these lateral members is termed the **receptacle** (*r*).

The outermost series of lateral members is formed by a whorl of five small, green, leaf-like *sepals* (*sp. cal*).

Standing immediately within the gaps between the five sepals, and thus alternating with them, are five yellow, leaf-like **petals** (*p. cor.*).

Again, within these succeed numerous yellow **stamens** (*and*). Each stamen consists of a stalk—the *filament* (*f*)—and a head — the *anther* (*a*). The young anther has four closed little chambers — the *pollen-sacs*—which contain innumerable microscopic rounded bodies

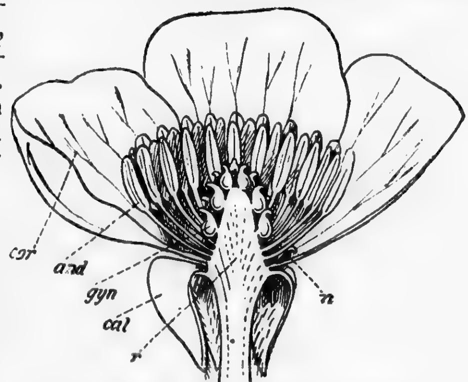


Fig. 61.—Vertical section of flower of Buttercup.

—the *pollen-grains.* When the anther is fully ripe, the pollen-sacs open down their sides and allow the pollen to escape in the form of fine yellow dust.

The centre of the flower is occupied by many small green **carpels** (*gyn*) situated laterally on the terminal portion of the axis. Each carpel, at its summit, terminates in a minute glistening tip — the *stigma* (*st*), which is connected by a scarcely appreciable short stalk — the *style* (*s*) — with the swollen basal portion—the *ovary* (*ov*). The ovary is inserted directly on the receptacle. The ovary forms a closed chamber which contains a minute egg-shaped body—the *ovule* (*o*)—attached to its floor.

FLOWERS OF THE SCOTCH PINE (FIGURES 63-67).

The flowers of the Scotch Pine are very different in appearance and in structure. This plant has two kinds of flowers (fig. 62)—those which possess stamens (*m*), and those which bear carpels (*c*, *cP*).

The stamen-bearing flowers are yellow cones clustered together (fig. 62 *m*). Each cone (fig. 63) is a single flower with a short stalk, and stands in the axil of a scale (*sc*). The simple axis of the cone has a basal portion which bears simple bract-scales (*s*). Above these, on the axis, are inserted lateral scales (fig. 63 *po*, fig. 64), each of which has two pollen-sacs attached to its lower face. These latter scales are stamens, for they possess pollen-sacs. The flower thus consists of a simple axis—the receptacle—with spirally arranged lateral stamens. At its base the receptacle is continuous with a short portion of the axis—the flower-stalk—to which bracts are attached.

The carpel-bearing flowers (fig. 62 *c*, *cP*) are also cones, and present the appearance of erect reddish buds. Each cone (fig. 65) arises in the axil of a scale: its simple axis is continuous with a short stalk which bears a few bracts (*sc*). Above these bracts the simple receptacle has scale-like members of somewhat complicated form, each member consisting of a small scale (*cp*), from the upper face of which a larger scale (*ps*) protrudes: again attached to the upper surface of each larger scale are two ovules (fig. 66 *ov*). These peculiar double-scales are carpels, for they bear ovules. The

flower thus consists of a simple axis with spirally-arranged carpels; it has a short stalk, which is continuous with the receptacle.

DEFINITION OF A FLOWER.

Widely different as they are, the flowers of the Scotch Pine and Buttercup agree in that each consists of a simple axis bearing lateral members unlike itself. Thus the flower agrees with a simple shoot as regards its component parts, and there are reasons for regarding the flower as actually equivalent to a shoot—(i.) a flower always occupies the position of a shoot: it either terminates a shoot (*e.g.* Tulip, Bulbous Buttercup), or is in the axil of a foliage-leaf (*e.g.* Poor-man's Weather-glass), or of a bract (*e.g.* Scotch Pine, Hyacinth). Thus the receptacle of a flower is a simple stem, because it is continuous with a stem which bears leaves, or is axillary in position. (ii.) The lateral floral members—sepals, petals, stamens, and carpels—are leaves, as is proved by the following considerations:—

(*a*) Like leaves, they are arranged laterally on stems in whorls (*e.g.* petals of the Buttercup), or in spirals (*e.g.* stamens and carpels of the Buttercup and Scotch Pine).

(*b*) They are often distinctly leaf-like in form (*e.g.* sepals and petals of the Buttercup, stamens and carpels of the Scotch Pine).

(*c*) Frequently plants possess lateral members, which are arranged like leaves and assume forms intermediate between bracts, sepals, petals, or stamens. Thus in the Christmas Rose there are all stages of transition between the foliage-leaves, bracts, and sepals. In the White Water-lily there are numerous lateral floral members which in form are intermediate between petals and stamens.

(*d*) The flowers of a plant may assume peculiar abnormal forms in which the lateral floral members are strangely modified; such flowers are described as being *monstrous*. In "Double Buttercups" some of the stamens are replaced by petals; in green roses green leaves appear in place of carpels.

(*e*) Lateral floral members differ from ordinary leaves in that they have no buds in their axils; but in some monstrous flowers buds do appear in their axils.

Thus the position of a flower and the arrangement of its

various parts prove that it is equivalent to a simple shoot. Further, we are familiar with the fact that seeds form in connection with flowers, but on no other part of the plant. We may, therefore, give the following definition of a flower:—*A flower is a simple shoot, or part of a simple shoot, which is set apart for the purpose of effecting reproduction by means of seeds.* The lateral members—sepals, petals, stamens, and carpels—represent leaves, and may be described as *floral leaves.*

Comparing the flowers of the Scotch Pine and Buttercup, it is apparent that there is a great difference between their carpels. They are types of the two great natural classes into which we divide flowering plants. (i.) **Gymnosperms,** which include Pines, Firs, Cedars, etc., have their ovules freely exposed on open carpels. (ii.) **Angiosperms,** which include the majority of familiar flowering plants—Buttercups, the Wallflower, the Hazel, Grasses, and Lilies, for instance—have closed carpels, so that the ovules are concealed inside an ovary. Further, a carpel of an Angiosperm has several differentiated parts—an ovary, a stigma, and usually a style.

CHAPTER VII *

GYMNOSPERMÆ

CONIFERÆ (PINE FAMILY)

Trees or shrubs with simple leaves and inconspicuous naked diclinous Flowers. The ovules are borne on open carpels.

Type: SCOTCH PINE (*PINUS SYLVESTRIS*).

Vegetative Characters.—A tall evergreen, resinous tree. (Consult fig. 62 for an explanation of the following descrip-

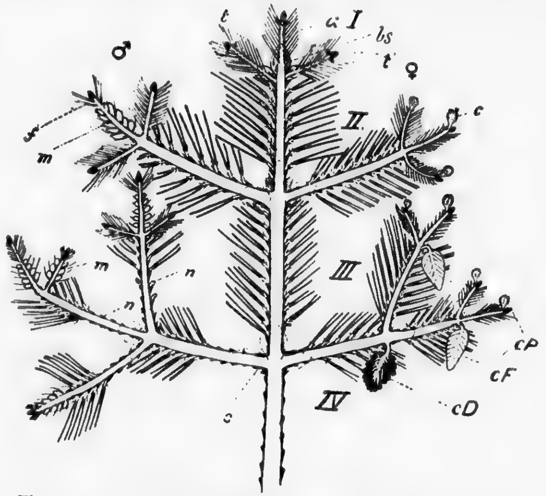


Fig. 62.—Diagram of branching of *Pinus sylvestris*, also showing the position of flowers.

tion.) The obvious branches (lateral long-shoots) are arranged in false whorls. The vegetative shoots and leaves are of two

* Beginners should omit this chapter.

kinds (see p. 24). At the end of each active vegetative season the terminal bud (*bs*) of the main stem (or of a lateral long-shoot (*t*,'*t*)) enters into a resting condition, and close beneath it the axillary buds form a whorl-like collection of scaly resting buds. These terminal buds, and the lateral ones (excepting such as develop into cones), grow out in the following year to form long-shoots. Consequently, the number of false whorls of long-shoots denotes the number of years of growth of the stem which bears them; it is, however, necessary to add three to the number thus obtained if we wish to calculate the age of a tree, because no false whorls are formed till the end of the third year of the life of the main stem. In fig. 62 the part of the stem above the top whorl of branches, and opposite I. is a one-year-old stem; that part (II.) between the uppermost whorl and the second whorl is a two-year-old stem, and so on.

63

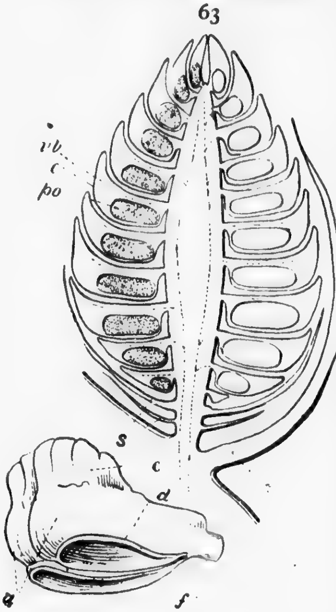


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Fig. 63.—Vertical section of staminate flower of Scotch Pine.
Fig. 64.—Stamen of ditto.

Inflorescence and Flowers.—The staminate and carpellary flowers have been described on page 44. They arise in the axils of scale-leaves on the long-shoots. (Consult fig. 62.) The open flowers are found only on the young shoots of the current year. The carpellary flowers (*c*, *cP*) are small erect lateral cones, often two or three together, immediately behind the terminal bud of the long-shoot. They occupy positions similar to the lateral buds which would grow out to form long-shoots. But the staminate flowers (*m*) are inserted laterally on the more basal parts of the long-shoots of the current year—that is, they are just above the uppermost false whorl of

branches, and occupy positions taken by dwarf-shoots on vegetative branches. Above the spike-like inflorescence of staminate flowers, a few foliaged dwarf-branches are seen. On older shoots, two to three years old, the spurs (*n*) or scars of the fallen staminate flowers denote the points at which the latter were attached. Thus a carpellary flower takes the place of a lateral long-shoot; whereas a staminate flower replaces a vegetative dwarf-shoot.

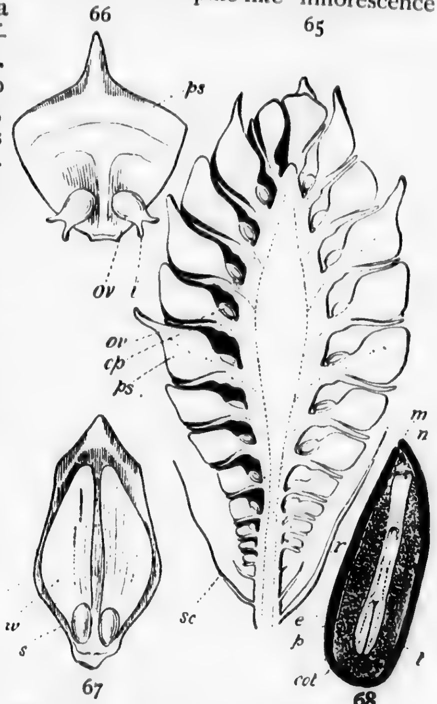

Fig. 65.—Vertical section of carpellary flower of Scotch Pine.
Fig. 66.—Carpel of ditto.
Fig. 67.—Carpel of fruit of ditto, with two seeds (*s*) having wings (*w*) in contact with them.
Fig. 68.—Vertical section of seed of ditto; *e*=endosperm; *cot*=cotyledons; *p*=plumule; *r*=radicle; *m*=micropyle.

Pollination and its consequences.—The flowers are pollinated by the agency of the wind. When ready for pollination in May, the carpellary cone stands erect (*c*, *cP*). Its axis (receptacle) elongates, and thus causes the carpels to separate to a slight extent. The pollen-grains which are blown against the cones naturally reach the crevices between the carpels. They then roll down the prominent rib of the placental scales, and thus meet with the integuments of the ovules. The integuments curl up slightly, and carry the pollen towards the top of the nucellus —that is, towards the bottom of the micropyle-passage. In the Pine, the pollen-grain itself reaches the micropyle, whereas

in Angiosperms it is conveyed only as far as the stigma. After pollination the carpels again close together, and the placental scales become hard, green, and woody. Each cone gradually bends over till it finally points downwards (*cF*), and its closely set scales become brown in colour. Finally, the hard brown scales separate at their tips, and allow the seeds to be set free. The escape of the seeds does not take place till more than a year after pollination; a few seeds may escape in the October of the year following pollination, but the majority (*cD*) remain on the tree till about two years subsequent to pollination, when the woody carpels gape apart as they dry. The **fruit** of the Pine is a cone of woody carpels. The ovule develops into a hard endospermic **seed** (fig. 68), containing an embryo which possesses a whorl of cotyledons (*cot*). Attached to the seed is a separable wing (fig. 67 *w*), which is not really a part of the seed, because it is formed by a layer of the scale. The wings act as sails, through the aid of which the seeds are scattered by the wind; the wind blows the seed, causes it to spin, and so delays its journey to the soil. In addition, the cones drop off and are blown along the ground, shedding at the same time any seeds they may contain.

As **other members** of the Coniferæ we may quote the Larch (which is deciduous), the Yew (the seed of which has a red fleshy aril), and the various Cypresses, Cedars, and Monkey-puzzles cultivated in gardens.

CHAPTER VIII

ANGIOSPERMÆ

INFLORESCENCE

EACH flower of a plant may be *solitary*, either in a terminal position, as in the Tulip, or in the axil of a foliage-leaf, as in the Poor-man's Weather-glass. On the other hand, a plant may have its flowers grouped together and subtended by simplified leaves in place of foliage-leaves. Such a group of flowers is described as an *inflorescence*. The distinction between a flower and an inflorescence lies in the circumstance that the axis of a flower is unbranched, whereas the axis of an inflorescence is branched. The axis of a flower bears floral leaves; whereas the axis of an inflorescence bears lateral shoots in the axils of bracts. We may therefore define an inflorescence as a branched shoot set apart for the purpose of accomplishing reproduction by means of seeds. Like a vegetative stem, the main axis of an inflorescence may be continuous with the axis of a foliaged shoot, in which case it is said to be *terminal—e.g.* Foxglove and Wallflower; or the inflorescence may arise in the axil of a leaf, when it is described as *axillary—e.g.* Pea and Hazel.

Just as a vegetative stem may branch in a racemose or a cymose manner, so may a reproductive axis. Remembering that a flower represents a simple shoot, and occupies the position of bud, it is easy to define racemose and cymose inflorescences (compare page 26).

A. RACEMOSE INFLORESCENCES.

In this type of inflorescence the main axis grows more strongly than its lateral axes, and bears a considerable number of branches. These branches may themselves be flowers, as in the Hyacinth, in which case the inflorescence is said to be of the *simple racemose* type. Or the main inflorescence-axis

may bear lateral inflorescences in place of flowers, as in the

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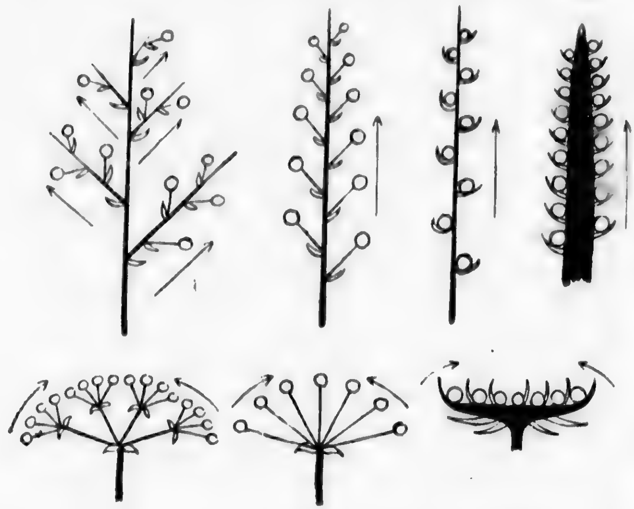

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Figs. 69-75.—Diagrams of Racemose inflorescences. The arrows denote the general order of succession in the opening of the flowers.

Parsley, and the inflorescence is described as being *compound racemose.*

I. *Simple Racemose Inflorescences.*—The main axis of the inflorescence directly bears a number of flowers.

(*a*) The flowers are separated by distinct internodes, so that the axis is elongated.

(α) The flowers are stalked (fig. 70) = **Raceme.**
Examples—Hyacinth, Foxglove.

(β) The flowers are not stalked.

(i.) The main axis is not fleshy (fig. 71) = **Spike.**
Example—Spikelet of Grasses.

(ii.) The main axis is fleshy (fig. 72) = **Spadix.**
Example—*Arum.*

(iii.) A *catkin* (fig. 131, ♂) is an inflorescence of inconspicuous sessile, staminate or carpellary, flowers: after flowering it usually drops off as a whole. It is racemose in type, but in the axils of the bracts cymes may occur in place of single flowers, in which case the catkin is a compound inflorescence.

(*b*) The flowers are set close together on a shortened main axis.

(α) The flowers are stalked = **Umbel.**

The umbel exhibits a considerable number of flowers springing from the shortened terminal part of the axis. Usually there is a terminal flower in the inflorescence. An umbel is essentially a condensed simple raceme (fig. 74).

Example—Ivy.

(β) The flowers are not stalked (fig. 75) = **Capitulum.**

The shortened terminal part of the main axis bears a number of closely-clustered stalkless flowers, forming a capitulum or head.

Examples — Sunflower (fig. 208), Dandelion (fig. 253), Daisy.

II. *Compound Racemose Inflorescences.*—The main axis of the inflorescence does not itself bear flowers, but has lateral branches which are inflorescences. The main type of branching of the inflorescence is termed the main or primary inflorescence, and the lateral inflorescences are styled the secondary inflorescences, etc.

(*a*) The main axis is elongated, so that its branches are separated by distinct internodes.

(α) The main axis bears lateral racemose inflorescences with stalked flowers (fig. 69) = **Panicle.**

(β) The main axis bears somewhat shortened lateral inflorescences which are spikes (fig. 231) = **Compound Spike.**

Example—Wheat.

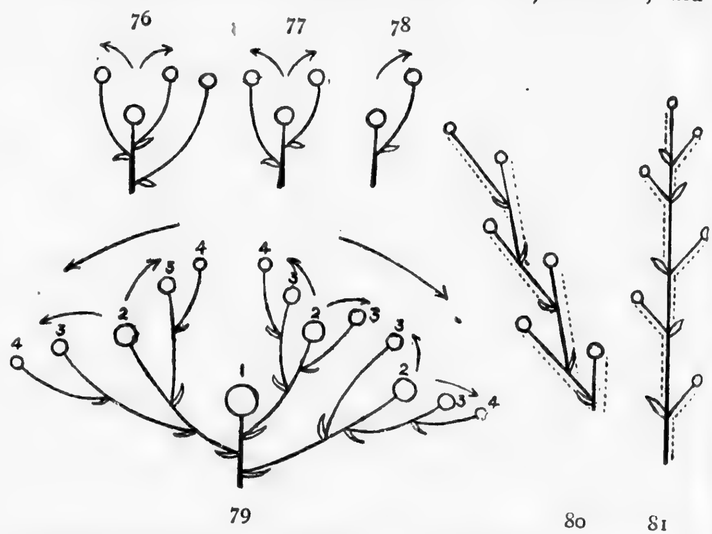
(*b*) The main axis has its lateral inflorescences set closely together to form an umbel, and the lateral inflorescences are in turn umbels (fig. 73)

= **Compound Umbel.**

Examples—Parsley, Carrot.

B. CYMOSE INFLORESCENCES.

In this type of inflorescence every axis grows only for a limited, *definite* period, and terminates in a flower; each axis possesses only a very few (usually one or two) branches, and



Figs. 76-81.—Diagrams of Cymose inflorescences. The arrows denote the general order of succession in the opening of the flowers. Fig. 81 also shows a sympode formed from fig. 80 by the successive displacement of each terminal flower: each dotted line denotes a single axis.

these latter grow more strongly than the inflorescence-axis which bears them. Usually the flowers at the apex of a cymose inflorescence open before those on the branches, so that they do not open in acropetal succession.

There are three main types of cymes—

(1) Several-branched. The main inflorescence-axis has more than two branches (figs. 76, 79).

Example—Some Spurges.

(2) Two-branched. The main inflorescence-axis has only two branches (figs. 77, 43), and is termed a forked-cyme = **Dichasium.**

Example—Many members of the Pink-family.

(3) One-branched. The main inflorescence-axis has only one branch (figs. 78, 80, 81) = **Monochasium.**

Example—Some Geraniums.

The so-called *scorpioid cyme* of the Borage-family is most properly regarded as a monochasium: its axis is a sympodium (compare figs. 80 and 81).*

In cymose inflorescences often the main (primary) inflorescence and lateral (secondary, etc.) inflorescences are of different types. The main inflorescence, for example, may be a several-branched cyme, and its branches may be dichasia, and their branches ultimately bear monochasia (as in the Petty Spurge). Frequently the main inflorescence is a dichasium and the lateral inflorescences are monochasia (as often in the Dead Nettle family).

BRACTS.

These are usually small and simple (see page 21). In the Wallflower-family the inflorescence is frequently devoid of bracts. In capitula the individual flowers may be without subtending bracts, as in the Dandelion. The opposite extreme is reached in the Arum, where a large bract—the *spathe*—encloses the inflorescence. Capitula and umbels usually have closely-set collections of bracts, termed involucres; even single flowers may have similar involucres beneath them, as in the Mallow.

Prophylls.—On page 21 it has already been mentioned that the first leaf of a branch in Monocotyledons, and the first two leaves in Dicotyledons, are often small and simple, and occupy definite positions with reference to the main axis. These

* Some modern botanists, laying undue stress on the development of this inflorescence, conclude that it is racemose in type, and that the axis is a true axis. This view is undoubtedly incorrect.

leaves are termed the prophylls. The same holds good for the branches of inflorescences. Thus the stalk of each lateral flower of a Monocotyledon often has a prophyll on that face (posterior face), which is towards the axis bearing it. In Dicotyledons, the stalk of a lateral flower often has two prophylls on its sides, as is shown in fig. 98 *pr*, and is clearly seen in the Violet (fig. 158, *3*). These prophylls are therefore bracts occupying definite positions in the inflorescence. Occasionally no prophylls occur on the flower-stalk: examples, Wallflower, *Arum maculatum*.

CHAPTER IX

THE FLORAL LEAVES

PERIANTH

Of the floral leaves which, together with the receptacle, constitute a flower, those which are inserted outside the stamens and carpels compose the *perianth*. The perianth may be clearly differentiated into sepals and petals, or all its leaves may be alike.

CALYX.

The whole collection of sepals belonging to a single flower constitutes the *calyx*. In its simplest condition the calyx consists of a whorl or spiral of separate, simple sepals (*e.g.* Buttercup, Poppy), which are attached to the receptacle usually by relatively broad bases. The calyx is then said to be *polysepalous*. Often, however, the sepals are combined to form a more or less cup-like calyx (*e.g.* Pea, White Dead Nettle), and are then described as being *gamosepalous*. Even when the calyx is gamosepalous it is usually possible to ascertain the number of sepals which comprise it, because from the rim of the cup a corresponding number of free portions, lobes or teeth, protrude. For example, the gamosepalous calyx of the Dead Nettle has five long teeth, and consists of five sepals.

The sepals may form a single whorl of two (*e.g.* Poppy) or more (*e.g.* five in the Buttercup) members. Less frequently the flower has more than one whorl of sepals, as in the Wallflower, in which the sepals form two whorls of two each. On the other hand, the sepals may be arranged in a spiral manner.

In the case of the flowers of many plants the calyx merely serves to protect the inner parts of the flower whilst the latter is in the bud-condition. When this protective function is no longer called for, because the flower has opened, the sepals may fold back, as in some Buttercups, or fall off, as in the

Poppy (fig. 153 *sep*). When the younger flowers are crowded together and do not require protection on the part of the calyx, the latter is frequently small or even absent, as in the Daisy-family. As a rule the sepals are green, but in some flowers the sepals are brightly coloured—*e.g.* *Clematis* and *Anemone*—and are said to be *petaloid;* in this case they perform the functions of petals in serving to attract the notice of insects. In the Wallflower-family two of the sepals tend to be sac-like at their bases, and serve as receptacles for honey. Sometimes the calyx persists even when the fruit is formed; an interesting example of this occurs in the Dandelion (fig. 129), the flower of which possesses a circle of many fine silky hairs, forming the *pappus*, in place of the calyx. The pappus aids in the dispersal of the fruit by the agency of the wind.

Epicalyx.—Outside the calyx of a flower there sometimes stands a whorl, or whorl-like collection, of members apparently forming an outer calyx, which is known as the epicalyx. The epicalyx of the Mallow (fig. 163 *bc*) is in reality not a part of the flower, but is an involucre of bracts. The epicalyx (fig. 82 *ep*) of the Strawberry-flower consists of a whorl of five small green members, which alternate with the five sepals and represent the stipules of the latter: in this instance the epicalyx is truly a part of the flower, as it is a portion of the calyx.

Fig. 82.—**Calyx** and epicalyx of Strawberry.

COROLLA.

The whole collection of petals of a single flower constitutes the *corolla*. In its simplest condition the corolla is *polypetalous*, —that is, it consists of a number of separate petals, as in the Buttercup, Wallflower, and Poppy. Each petal (fig. 83) is typically bright-coloured, flattened and inserted by a relatively narrow base; often it is distinguishable into two parts, a lower narrow portion (*cl*)—the *claw*—and an upper broad part (*la*)—the *blade*. In many flowers, however, the petals composing a single whorl are combined to form a shorter or longer tube, and the corolla is said to be *gamopetalous*—*e.g.* Primrose, Dead Nettle, and Potato (fig. 84 *co*).

The petals form a single whorl (*e.g.* Buttercup, Primrose) or

two (*e.g.* Poppy) or more whorls. In some flowers the petals are spirally arranged—*e.g.* "Double Buttercups."

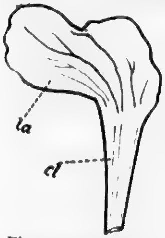


Fig. 83.—Petal of Wallflower.

When the perianth of a flower does not consist of sepals and petals clearly distinguishable from one another, but is composed of a single whorl—*e.g.* Clematis—or a continuous spiral of floral leaves, we assume that the corolla is absent, and describe the flower as *apetalous*; in fact, we regard the single whorl or spiral of the perianth as representing a calyx. To this rule there are exceptions, as examples of which plants belonging to the Daisy-family and Parsley-family may be cited. Each flower of the Parsley (compare fig. 183) has a calyx (*ca*) in the form of a small green ring with five minute teeth; its corolla consists of five white petals alternating with the calyx-teeth. But the flowers of some other representatives of the same family, though they possess five white floral leaves occupying the same position with reference to the stamens and carpels as in the Parsley, yet have no appreciable ring of teeth to correspond with the calyx of this plant. It is clear that in this case the single perianth-whorl of five white floral leaves represents the corolla, and the calyx is absent. Similarly, in the Daisy-family, the calyx is frequently small or absent (fig. 209).

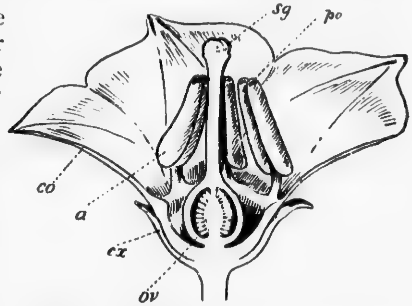


Fig. 84.—Vertical section of flower of Potato: *cx*=calyx; *co*=corolla; *a*=anther; *po*=pores of anther; *ov*=ovary; *sg*=stigma.

The chief function of the corolla is to render the flower conspicuous so as to attract the notice of insects (see page 80). When the flower does not profit by insect-visits the corolla is small and inconspicuous, as in certain flowers of the Violet, or absent, as in the Hazel. Even in cases in which the visits of insects to a flower benefit the plant, the petals are absent when the notice of the insects is sufficiently secured by the attractive nature of conspicuous sepals (*e.g.* Clematis),

stamens, or bright-coloured bracts. Occasionally the petals further allure insects by manufacturing honey—for example, the little pockets at the base of the Buttercup-petals are honey-manufacturing organs—*nectaries*—(figs. 60, 61 *n*). Finally the petals may serve as a receptacle and hiding-place for the honey poured out by the nectaries—*e.g.* spur of the Violet. In other words, the corolla is concerned in securing insect visits: accordingly, when the seeds begin to form in the flower, the corolla is no longer required, and it speedily withers.

PERIANTH.

When the perianth consists of two or more whorls of members which are all alike, the latter are termed perianth-leaves. For instance, Tulips and Hyacinths have perianths composed of two whorls of floral leaves which are all similar, and cannot be differentiated into three sepals and three petals. The perianth may be brightly coloured (*petaloid*), as in Tulips, Lilies, and Hyacinths; or it may be green (*sepaloid*). If the perianth-leaves be separate, they are said to be *polyphyllous*—*e.g.* Tulip; if they form a coherent tube the perianth is *gamophyllous*—*e.g.* Hyacinth (fig. 213).

Naked flowers (figs. 132, 148).—Flowers may be devoid of sepals—*e.g.* some Compositæ; or without petals—*e.g.* *Clematis*; finally, they may possess no perianth whatever, in which case they are said to be *naked*—*e.g.* the stamen-bearing flowers of the Hazel and the Petty Spurge, and the flowers of *Arum maculatum*. Such flowers consist solely of one or more stamens or carpels, or both of these, inserted upon a receptacle.

ANDRŒCIUM.

The whole collection of stamens of a flower constitutes the *andrœcium*.

A stamen usually consists of two parts, the filament and the anther. Occasionally the filament is absent, and the anther is consequently sessile. More rarely the anther is absent, and the sterile stamen thus formed is termed a *staminode*. The anther generally consists of two halves or *lobes*, and each half has two pollen-sacs in which the pollen-grains are lodged (fig. 85). Occasionally an anther represents half a complete anther and

possesses only two pollen-sacs—*e.g.* Mallow and Hazel. The two lobes of the anther are connected by a continuation of the filament, which is termed the *connective* (*co*). The connective may be a narrow, almost imperceptible, continuation of the filament, so that the two halves of the anther are close together; or it may be wider, and thus cause the anther-lobes to be clearly separated. Occasionally the connective is continued beyond and above the rest of the anther to form a flap-like process—*e.g.* Violet (fig. 158, *5*, *c*), and some Compositæ.

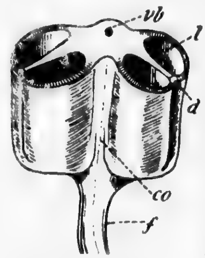


Fig. 85.—Part of a stamen with the top of the anther cut off.

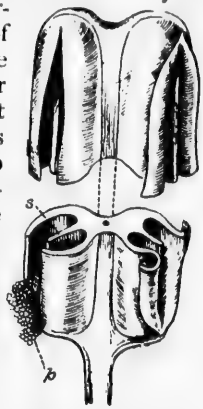


Fig. 86. — Longitudinal dehiscence of anther, showing the escaping pollen (*p*).

The stamens may be separated from one another, or they may be united by their filaments or anthers. In the Mallow (fig. 161) and some of the members of the Pea-family, the filaments of all the stamens in a flower are united for a certain distance so as to form one bundle; in some other members of the Pea-family (fig. 87) nine of the ten stamens are similarly united (*an. t*) by their filaments, but the tenth is separate (*p. a*). In the Daisy-family the filaments of the stamens are separate, but their anthers cohere (fig. 202).

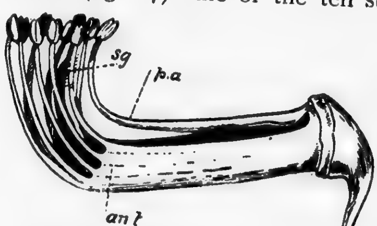


Fig. 87.—Flower of Garden Pea, with calyx and corolla removed.

Like the sepals and petals, the stamens may form one whorl—*e.g.* Violet; or several whorls (two whorls in the Wallflower, *Geranium*, and Hyacinth; many whorls in the Poppy). Or the stamens may be arranged spirally on the receptacle—*e.g.* Buttercup.

Usually all the stamens of a flower are similar in form and size. In the Wallflower-family (fig. 88), however, the andrœ-

cium consists of six stamens, of which two have shorter filaments (*at*) than the remaining four (*am*). Many members of the Foxglove—and Dead Nettle-family (figs. 191, 193) have flowers with four stamens, two of which have shorter filaments. Again, in some members of the Geranium-family, the flower may possess five stamens with anthers, and five without.

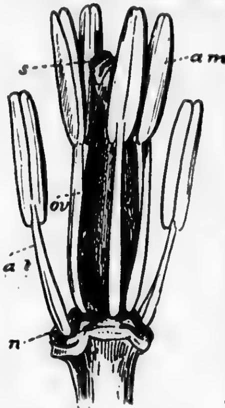


Fig. 88. — Flower of Wallflower, with calyx and corolla removed: *n*=nectary; *at*, *am*=stamens; *ov*=ovary; *s*=stigma-lobe.

Dehiscence and insertion of the anther.—When the anther is ripe, the pollen-sacs open in such a manner as to permit the escape of the pollen. Usually each anther-lobe opens by one split down the line which denotes the junction of the pair of pollen-sacs (figs. 85 *d*, 86): its dehiscence is *longitudinal*. Occasionally the anther opens by small circular holes—*e.g.* Potato (fig. 84 *po*): this dehiscence is *porous*. Or, finally, the anther may open by small doors or valves—*e.g.* Barberry: this dehiscence is *valvular*. When an anther opens on the face towards the centre of the flower, its dehiscence is *introrse*—*e.g.* Violet and Daisy-family; but when it opens towards the periphery of the flower, dehiscence is *extrorse*; finally, when the anther dehisces neither in an inward nor an outward direction, but opens along the edges, the dehiscence is *marginal*. Unfortunately the terms extrorse and introrse are also employed in another sense. An anther which is inserted in such a manner that its lobes and pollen-sacs appear to face the centre of the flower is described as *introrse*: when the pollen-sacs appear to face the periphery of the flower the anther is *extrorse*; finally, there remains a third class of anthers, in which two pollen-sacs face the centre of the flower, and two face the periphery. Frequently the direction of dehiscence corresponds with the mode of insertion of the anther, but this is not invariably the case; for example, though an anther with introrse dehiscence is often found to be introrse in insertion, it is not always the case.

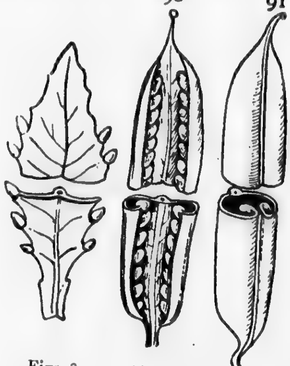
GYNÆCIUM.

The whole collection of carpels of a single flower constitutes the gynæcium.

APOCARPOUS GYNÆCIUM.

The simplest type of carpel met with amongst Angiosperms is that of the Pea or Bean (fig. 91). Its summit is formed by the *stigma*, which is connected by the stalk-like *style* with the pod-shaped *ovary*. The ovary forms a closed vessel with a single cavity, in which are a number of ovules. That precise part of the ovary upon which the ovules are immediately inserted is described as the *placenta*; in this case the placenta assumes the form of a protruding line running straight up the one side of the ovary, and bearing a double row of ovules. The carpel of the Pea looks much like a small leaf, the two halves of which have folded along the mid-rib and joined at the margins, the ovules being attached to the incurved margins. And we assume that the carpel is a leaf which has thus become coherent at its margins. Figs. 89, 90, 91, show the successive stages by which such a carpel could have been built from a leaf with marginal ovules. A Gymnosperm—*Cycas*—has an open carpel, very like that shown in figure 89. When their ovaries have become fruits, the carpels of the Christmas Rose and the Winter Aconite are half-opened, as shown in fig. 90. In a simple closed carpel like that of the Pea, the line which corresponds to the fused margins of the leaf is termed the *ventral suture* (fig. 119 *vs*), whilst the line which corresponds to the mid-rib is the *dorsal suture* (*ds*).

89 90 91



Figs. 89-91.—Single carpels.

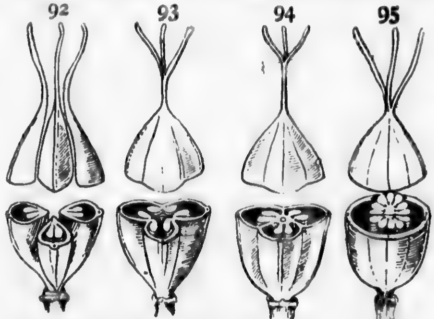
Each carpel of the Buttercup (fig. 60) is essentially like that of the Pea, excepting that it contains only one ovule (*o*), which is attached to the floor of the ovary-chamber.

The flower of the Pea contains only one carpel: that of the Buttercup has many carpels; but in both cases the gynæcium

is said to be *apocarpous*, because it is not made up of several carpels joined together. Fig. 92 shows an apocarpous gynæcium composed of three carpels.

SYNCARPOUS GYNÆCIUM.

When a flower possesses more than one carpel, and its carpels cohere together to form a single body, the gynæcium is said to be *syncarpous*. In such a gynæcium the ovule-containing parts (ovaries) of the carpels are joined together to form a single ovary, which is also described as being syncarpous (figs. 93, 94, 95). But the styles may remain separate along their whole lengths (fig. 95); or along part of their lengths (fig. 95). Again, not only may the ovaries be completely fused, but also the styles, so that only the stigmas remain distinct in the form of stigma-lobes (*e.g.* Wallflower); or finally, the ovaries, styles, and stigmas of the constituent carpels are completely joined together —*e.g.* Primrose. The syncarpous ovary, representing as it does parts of several carpels, may have several chambers, each corresponding to one carpel.* Thus the Hyacinth has three carpels joined to form a single ovary, which is three-chambered; or the syncarpous ovary may have one general chamber, the wall of which is formed by several carpels joined together (*e.g.* Violet).



Figs. 92-95.—A gynæcium composed of three carpels. Fig. 92 is an apocarpous gynæcium; the other three figures represent syncarpous gynæcia.

PLACENTATION.

The mode of arrangement of the ovule-bearing portions—the placentæ—of the ovary is referred to under the head of

* Rarely these chambers of the ovary are further sub-divided by additional partitions, so that the chambers of the ovary are more numerous than the carpels composing it—*e.g.* Labiatæ, Boraginaceæ.

placentation. When the ovules are attached to the walls of the ovary the placentation is *parietal* (fig. 93, *e.g.* Violet, Poppy, Wallflower, Pea); an ovary with parietal placentas is usually one-chambered, but in the Wallflower-family the ovary has two parietal placentas, and yet is two-chambered. When the ovary is syncarpous and has several chambers, and the ovules are attached to the central axis of the ovary (where the carpels meet), the placentation is *axile* (fig. 94, *e.g.* Hyacinth). If a chamber of an ovary contains only one ovule which is attached to its floor, the placentation is *basal* (*e.g.* Buttercup). Finally, when the ovary is one-chambered, and possesses a number of ovules attached to a swelling springing from the floor of the ovary, the placentation is *central* (*e.g.* Chickweed) or *free-central* (fig. 95, *e.g.* Primrose).

Methods of ascertaining the number of carpels which compose a syncarpous gynæcium.—By definition a syncarpous gynæcium consists of several carpels joined together. The following rules enable us to learn how many carpels enter into the composition of an ovary:—

(i.) When an ovary has several chambers, each chamber represents one carpel.*

(ii.) If the ovary be one-chambered and the placentation parietal, the placentas correspond with the joined ventral sutures (margins) of the carpels, and consequently denote the number of carpels.

(iii.) If there be several styles, style-branches, or stigma-lobes, their number corresponds with the number of the carpels. Occasionally, however, the styles or stigmas branch so that this rule does not hold.

(iv.) When the fruit is ripe, the wall of the ovary frequently opens along as many lines as there are carpels.

(v. and vi.) Development, and comparison with closely-related plants, often aid us in determining the number of carpels (see next chapter).

As examples of the application of these methods, we may select the two cases. The Pea has a one-chambered ovary, with one style, one stigma, and one parietal placenta down one side. The gynæcium, therefore, consists of one carpel and is apocarpous, in spite of the fact that in the fruit-condition

* Exceptions to this rule occur in the Labiatæ and Boraginaceæ.

it opens along two lines. In the Wallflower the gynæcium consists of a two-chambered ovary with two parietal placentas, and one style with two stigmas; in the fruit-condition the ovary opens along two lines; therefore the gynæcium consists of two carpels which are joined together (syncarpous).

THE ABSENCE OF STAMENS OR CARPELS.

The majority of familiar flowers possess both stamens and carpels, and are said to be *monoclinous* (*e.g.* Buttercup, Wallflower, Pea, Hyacinth). But the stamens and carpels of some plants do not occur in the same flowers, which are then described as being *diclinous* (*e.g.* Hazel, Scotch Pine). A plant having diclinous flowers naturally will possess two kinds of flowers: *staminate* flowers, which have stamens but are without carpels; and *carpellary* flowers, endowed with carpels but devoid of stamens.

CHAPTER X

ARRANGEMENT OF THE FLORAL LEAVES

LIKE the leaves on the vegetative part of a stem, the floral leaves are arranged in whorls or in spirals. When all its floral leaves are arranged in whorls, a flower is said to be *cyclic* (*e.g.* Wallflower, *Geranium*, Hyacinth); but when they are inserted in spirals, the flower is *acyclic*. Finally, if some of its floral leaves are in spirals and others in whorls, the flower is *hemi-cyclic* (*e.g.* most species of Buttercups).

CYCLIC FLOWERS.

In the case of a cyclic flower which may be described as a model or a typical flower the following rules hold good:—(i.) The number of floral leaves in each and every whorl of the flower is the same. (ii.) The successive whorls alternate. (iii.) The floral leaves in each whorl are all alike. To take an example: suppose that a flower possesses five sepals, in each other whorl of the flower there should be five floral leaves; so there might be five sepals, five petals, ten stamens, and five carpels. The five petals will alternate with the five sepals, and will be succeeded by an alternating whorl of five outer stamens (which are therefore opposite to the sepals); the five other stamens will form an inner whorl, and will alternate with the five outer stamens (and therefore be opposite to the petals); finally, the five carpels will alternate with the five inner stamens. Comparatively few cyclic flowers conform with all the three rules laid down; they exhibit variations.

(i.) **Obdiplostemony.**—Some flowers have two alternating whorls of stamens, there being in each whorl the same number of stamens as there are petals in a whorl; but the outer whorl of stamens are opposite to the petals in place of alternating with them. In addition, it is frequently the case that when the number of carpels is the same as that of the petals, the

carpels alternate with the inner whorl of stamens, so that they are opposite to the petals in place of being opposite to the sepals (fig. 166). Such flowers are said to be *obdiplostemonous* (*e.g. Geranium, Oxalis*).

(ii.) **Unequal Growth.**—In many flowers the floral leaves which form a single whorl are not all alike in size and shape.

96 97

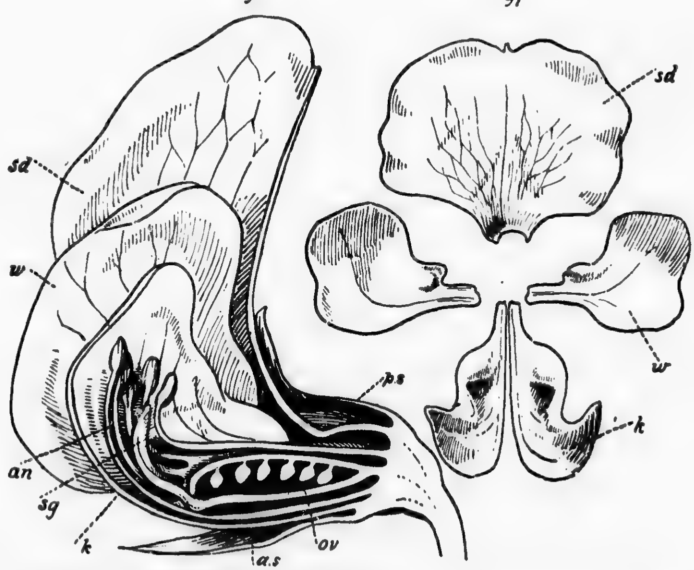


Fig. 96.—Vertical section of flower of Garden Pea. Fig. 97.—Separated petals of ditto.

The flower as a whole, or the whorl itself, is then said to be *irregular*. The corollas of the Pansy, Pea (figs. 96, 97), and Dead Nettle are irregular. In the Dead Nettle (fig. 191) two stamens with short, and two with long, filaments form one whorl. On the other hand, the andrœcium of the Wallflower (fig. 88) consists of two stamens with shorter, and four with longer, filaments; but the two short stamens form one whorl, and the four long ones comprise another, so that the andrœcium is not irregular. When all the floral leaves of each separate

whorl of the flower are alike, the flower is *regular* (*e.g.* Wallflower, Poppy, *Geranium*, Hyacinth).

(iii.) **Atrophy and Suppression.**—By the word *atrophy* we mean the dwarfed development of a structure: atrophy, therefore, is a special example of unequal growth. Staminodes are examples of atrophy; they are stamens which have not produced their anthers. Comparing various flowers of the Umbelliferæ or Compositæ: in some we find the calyx represented by five minute teeth (fig. 183 *cx*), it has undergone atrophy; in still others no calyx is represented, it is entirely missing, and we then speak of the *suppression* of the calyx. In the Foxglove and the Dead Nettle, though there are five sepals and five petals represented in each flower, only four stamens occur. In each case one stamen which should alternate with two of the petals is missing. In the Primrose and the Iris a whole whorl of stamens is suppressed: in the former flower, the outer whorl is absent (see p. 149), so that the five stamens are opposite to the five petals; in the latter flower the three inner stamens are wanting (see p. 173), so that the three carpels are opposite to the three stamens.

(iv.) **Fusion or Cohesion.**—It has already been noted that the sepals, petals, stamens, or carpels may be combined in place of being separate. Occasionally some of the floral leaves forming a whorl are so intimately joined together that there seems to be a smaller number than is really the case. Thus, in flowers the corolla of which is two-lipped and consists of five petals, two of the petals forming one lip may be so closely fused that the double nature of the lip is not distinguishable. In this case we know that the lip represents two petals either because it is opposite to one sepal or to one stamen: if it represented a single petal it should alternate with two sepals or two stamens (see p. 154).

(v.) **Branching or Doubling.**—The floral leaves may be branched or doubled so that a whorl appears to represent more members than is really the case. For instance, the four stamens of the staminate Hazel-flower are almost completely divided down the middle, so that a careless observer might imagine that eight stamens were present (fig. 132).

In all these instances of deviations from the typical cyclic flower it is possible to understand the real structure of the flower, by considering the rules already given. In particular,

there should be an equal number of floral leaves in each whorl, and the successive whorls should alternate. Often we are assisted in comprehending the apparent exceptions to these rules by observing the structure of flowers belonging to plants closely related, and therefore included in the same family (see Foxglove-family, page 157). And again we know that a foliage-leaf commences as a single little lump on the surface of the stem. A separate floral leaf arises in the same manner. If, therefore, we see five lumps grow out to form the commencement of the andrœcium of a flower, and they alternate with five outgrowths which are the beginnings of the petals, we can assume that the andrœcium is constituted of five stamens, however the stamens may cohere or branch subsequently.

Symmetry of Cyclic Flowers.—If we compare the flower of a *Geranium* or Hyacinth with that of a Pea (figs. 96, 97)

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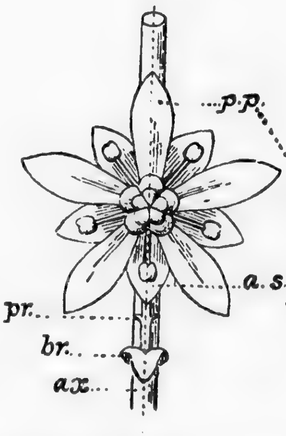

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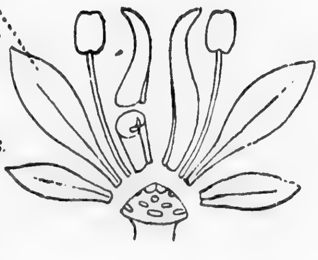

Fig. 98.—A regular actinomorphic cyclic flower on an axis (*a.x*) in the axil of a bract (*br*): *pr*=lateral prophylls; *a.s*=anterior sepal; *p*=posterior petal. The dotted line down the axis and over the flower is median.

Fig. 99.—The same flower showing the various floral leaves.

or Clover, we note that, in the case of the first two plants, all the parts are regular, and are arranged in such a manner that the flower can be divided down the centre into two equal

and similar halves by vertical cuts made in several different planes (directions); whereas in the other two plants named the parts are not regular, and the flower can be equally halved by a cut made only in one direction—*i.e.* passing through the middle of the standard and between the two keel-petals. All these flowers mentioned are said to be *symmetrical*, because it is possible to divide them into two similar halves. The *Geranium* and Hyacinth flowers are symmetrical in several planes (directions), or *actinomorphic*: the Pea and Clover flowers are symmetrical in one plane (direction) only, or *zygomorphic*. The zygomorphy of flowers is caused by the irregular growth, by suppression, by fusion, or by doubling of their parts.* When a cyclic flower cannot be divided into two equal halves, it is said to be *asymmetrical* (*e.g.* some members of the Pink-family). It is convenient to have some method of describing the relative positions occupied by the parts of a flower and the stem on which the latter is inserted. The half of the flower which faces the bract, or leaf, in the axil of which the flower stands, is said to be the *anterior* half; whilst the half of the flower which faces the inflorescence-axis is the *posterior* half. The plane dividing the flower vertically into its posterior and anterior halves is the *transverse* plane. Whereas

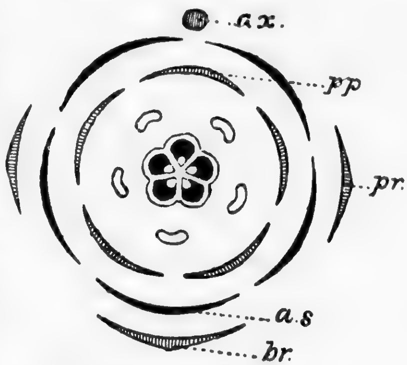

Fig. 100.—Floral diagram of same flower.

* In the majority of books a flower is not said to be zygomorphic when its solitary deviation from an actinomorphic flower is the suppression of some of its carpels. For example, many regular flowers possess five sepals, five petals, but only two carpels. If we assume that each floral leaf cut must be exactly halved, these flowers are, strictly speaking, symmetrical only in one plane: nevertheless, they are usually described as actinomorphic.

the vertical plane at right angles to the transverse plane, and, therefore, passing through the middle of the bract and the inflorescence-axis, is described as *median*. These definitions will be understood more easily if a Pea-flower (fig. 96) be examined. The standard is posterior (nearest the inflorescence-axis), the two keel-petals are anterior (nearest the bracts): furthermore, the standard is median in position, as it is inserted in a vertical plane passing through the middle of the bract and the inflorescence-axis: whereas the wings and the two keel-petals, being on each side of the median line, are lateral in position. Thus the standard is median-posterior, the wings are lateral, and the keel-petals are anterior-lateral (see also fig. 98).

ACYCLIC AND HEMICYCLIC FLOWERS.

Many of the remarks made in reference to cyclic flowers are also true of acyclic and hemicyclic flowers. But the definitions with regard to the symmetry of cyclic flowers usually do not hold good for hemicyclic and acyclic flowers, because the divergences of the various floral leaves are not constant throughout the whole flower. For instance, the sepals may be two-fifths, the petals three-eighths, and the stamens five-thirteenths. This renders it impossible to divide the flower with mathematical accuracy into two equal halves. Nevertheless, acyclic and hemicyclic flowers which present the appearance of actinomorphic flowers are usually described as actinomorphic (*e.g.* Buttercup), and those which resemble zygomorphic flowers are described as zygomorphic (*e.g.* Monkshood).

FLORAL DIAGRAMS.

In order to represent graphically the relative arrangement of the parts of a flower, we construct maps or ground-plans, which are known as *floral diagrams*. The simplest method of gaining an idea of a floral diagram is to cut across a flower-bud through the sepals, petals, stamens, and ovaries, and then to look down upon the cut surface exposed. The floral leaves will be seen to form successive circles or spirals. Figs 100 and 101 show floral diagrams. The sepals naturally stand at the outside, and the carpels in the centre (compare pages 13, 14). It is

also well to include in the diagrams the inflorescence-axis, and the bract or leaf in the axil of which the flower stands: we at once see which is the anterior and which the posterior part of the flower. The diagram will show where suppressions, etc., have taken place (see figs. 192, 194, 219).

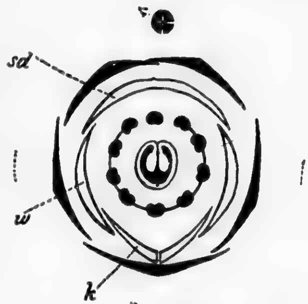

Fig. 101.—Floral diagram of Garden Pea.

Æstivation. — A cut made across a flower-bud further reveals the nature of the æstivation of the calyx and corolla. The sepals and petals, like leaves of vegetative buds, may be arranged in an *open*, a *valvate* (fig. 102), or an *imbricate* (figs. 103, 104) manner (see p. 128); especially frequent is the two - fifths æstivation of the calyx (fig. 104). The corolla is often *contorted* (fig. 103; fig. 166)—that is, one edge of each petal overlaps the edge of one adjoining petal, whilst its other margin is overlapped by the margin of the petal on its other side. The

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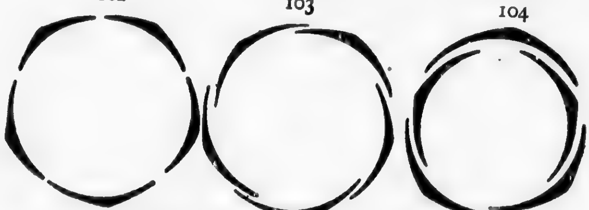


Figs. 102-104.—Diagrams of æstivation.

æstivation of the corolla of the Pansy (fig. 158) and Pea (fig. 101) is characteristic, and is described as *descending-imbricate*. In the bud, the posterior petals (or petal) enfold with their edges the lateral petals, and these in turn overlap the anterior petal (or petals). When the æstivation of the corolla is precisely the reverse, it is ascending-imbricate.*

* In a complete floral-diagram the æstivation of the calyx and corolla, the insertion of the anthers, as well as the position of main axis and bract, should be denoted; but young beginners might omit these details.

Floral formulæ and symbols.—Certain symbols and formulæ may be employed to denote briefly the morphology of a flower. The signs ⊕ and ↓ denote actinomorphic and zygomorphic flowers respectively; the direction of the arrow serves also to show the plane of symmetry. A vertical arrow ↓ corresponds with a median-zygomorphic, and a horizontal arrow → with a transverse-zygomorphic, flower. The signs ♂, ♀, ☿, denote respectively staminate, carpellary, and monoclinous flowers. The capital letters K C (P), A and G represent the calyx, corolla (perianth), andrœcium, and gynæcium. The number placed immediately after each capital letter shows the number of leaves in that particular whorl or spiral. If the gynæcium be syncarpous, its number is enclosed in brackets, otherwise the number is not in brackets; if the ovary be inferior, a horizontal line is drawn above its number, if it be superior the line is placed below the number. The sign ∞ denotes that more than twelve floral leaves are present, it therefore means numerous.

Floral formula of the ☿ flower of the Buttercup,

$$\oplus\ K5\ C5\ A\infty\ G\underline{\infty}$$

Floral formula of the ☿ flower of the Pea,

$$\downarrow K5\ C5\ A5+5\ G\underline{1}$$

Floral formula of the ♂ flower of the Hazel,

$$\oplus\ P0\ A4^2\ G0$$

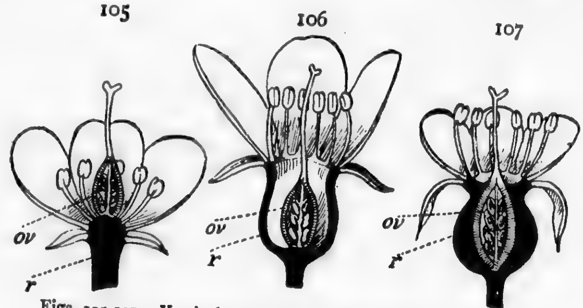
Floral formula of the ♀ flower of the Hazel,

$$\oplus\ P0\ (?)\ A0\ G\ (\overline{2})$$

SHAPE OF THE RECEPTACLE.

Hypogynous flowers (fig. 105).—In some simple flowers the portion of the stem which bears the floral leaves—that is, the receptacle—is distinctly elongated (*e.g.* Scotch Pine, figs. 63, 65; Buttercup, fig. 61). More frequently the internodes of the receptacle are much shorter, though the flower-stalk terminates in a rounded convex end (*e.g.* Wallflower, fig. 156; Poppy, fig. 153; Violet, fig. 158; Primrose, fig. 187). In such flowers the carpels occupy not only the most central, but also the highest, position; and petals and sepals are inserted at successively lower levels. The flower is then said to be *hypogynous*, and the gynæcium is *superior*.

Perigynous flowers (fig. 106).—The end of the flower-stalk of some other flowers is hollowed out to form a basin-like or deep urn-like concave receptacle. The carpels are attached to the



Figs. 105-107.—Vertical sections of flowers, showing the shape of the receptacle (*r*) which is shaded black: *ov*=ovary.

base (*e.g.* Cherry, fig. 177), to an outgrowth from the base (*e.g.* Blackberry, fig. 173), or to the sides and base (*e.g.* Rose, fig. 168), of the concavity, whilst the sepals and petals are inserted on its rim. The flower is then *perigynous*; the gynæcium is still described as *superior*.

Epigynous flowers (fig. 107).—Finally, there are flowers possessing a receptacle which is hollowed, as in the perigynous flowers, and the carpels are not only concealed in the concavity thus formed, but they are actually fused with and coherent to its sides. It thus becomes impossible to separate the wall of the ovary (or ovaries) from the receptacle, and the sepals and petals appear as if they were inserted upon the ovary (or ovaries). The flower is then described as *epigynous*. The gynæcium is, in this case, said to be *inferior* (*e.g. Heracleum*, fig. 183; Daisy-family, figs. 202, 209, 211; Honeysuckle, fig. 199; Daffodil, fig. 215). It will be seen that the wall of an inferior ovary really consists of portions of the carpels and of the receptacle.

Other peculiarities of insertion.—In hypogynous, perigynous, and epigynous flowers, frequently the stamens are attached to the petals (*e.g.* Primrose, Dead Nettle, Daisy-family); they are then said to be *epipetalous*. When the stamens are inserted on the perianth-leaves they are described as being *epiphyllous*

(fig. 213). In the Orchids the stamens and style combine to form a central column.

Disk.—Frequently the receptacle of a flower has upon it certain subsidiary outgrowths, which collectively form the *disk.* The disk may take the form of a whorl of two or more little swellings (*e.g. Geranium*, Chickweed) or scales; or it may be in the form of a single horse-shoe-like or ring-like outgrowth at the base of the style or stamens (*e.g.* Daisy-family), or may be a lining to the concave receptacle (*e.g.* Rose). Very frequently the disk secretes honey: in which case it is a nectary or a collection of nectaries.

CHAPTER XI

NECTARIES—POLLINATION

NECTARIES.

At the base of each petal of the Buttercup there is a small pit, the lining of which pours out sugar, and is termed a *nectary* or honey-gland. The petals of the Winter Aconite and Christmas Rose assume the form of tubes, which likewise excrete sugar, and are thus nectaries. The flower of the Monkshood (figs. 151, 152) has only two nectaries, which are attached by long stalks and represent portions of two posterior petals (*pp*), which are concealed beneath the large blue cowl-like posterior sepal. The two anterior stamens of the Violet or Pansy (fig. 158) send narrow band-like processes (*ap*) into the spur of the anterior petal; on each of these processes is a spot which denotes the location of the honey-gland. Thus, in the Pansy or Violet, we can distinguish between the nectaries which are portions of the stamens and make the honey, and the *nectar-receptacle* which is the spur of the anterior petal and receives the sugar manufactured by the nectaries. In the Marsh Marigold, and in *Arum*, parts of the gynæcium act as honey-glands; whilst in the Mallow the five nectaries are on the five sepals (fig. 161 *n*). In fact, sepals, petals, stamens, or carpels may be partially or wholly modified to excrete sugar. In other cases, however, the nectaries do not represent portions of the floral leaves, but are parts of the receptacle. For instance, in the flower of the Wallflower (figs. 88, 156 *n*) there are two honey-glands, each being in the form of a green ring-shaped outgrowth round the base of one of the short stamens; the two lateral saccate sepals act as honey-receptacles to receive the sugar overflowing from the two nectaries which lie above them.

POLLINATION.

Under certain circumstances the ovules of a plant change into seeds; in fact, seeds cannot be formed excepting from ovules.

Consequently, flowers which possess stamens, but have no carpels, do not bear seeds. Whereas flowers devoid of stamens, but endowed with carpels, may produce seed. Experiment has shown that the ovules do not change into seeds unless pollen grains have previously been conveyed on to the stigma (or, in Gymnosperms, into the micropyle of the ovule). The pollen in some way exerts a fertilising influence on the ovule. The transference of pollen from an anther to the receptive part of the carpel of a flower is referred to under the term *pollination.*

Cross - Pollination and Self - Pollination.—The simplest method of pollination is the transference of the pollen from the anther to the stigma of the same flower; this is described as *self-pollination*, and the flower is said to be *self-pollinated.* When, on the other hand, the stigma of a flower receives pollen from the flower of another individual-plant of the same kind, it is, said to be *cross-pollinated.* Lastly, pollen may be transferred from one flower on to the stigma of another flower of the same individual-plant; this is obviously a stage between cross-pollination and self-pollination, but there is no simple word or term in use by which to distinguish it.

CROSS-POLLINATION.

It has been proved that in many species of plants cross pollination leads either to larger crops of seeds, or to the production of seeds which are better in quality than is the case when the same plants are self-pollinated. Accordingly, many arrangements exist in flowers which are calculated to hinder self-pollination and facilitate the more invigorating cross-pollination.

Arrangements for hindering Self-pollination:—

(i.) Sometimes *the stamens and carpels do not occur in the same flowers*, consequently the pollen must be conveyed from one flower to another. The stamen-bearing (staminate) and carpel-bearing (carpellary) flowers may occur on the same individual-plant, as in the Hazel, Oak, and Pine. Or the two kinds of flowers may be on different individual-plants, as in the Willows, in which case the stamens are borne on one tree and the carpels on another tree.

(ii.) Sometimes *the stamens and carpels in one flower ripen at different times*; the consequence is that, though the

flower possesses both stamens and carpels, the pollen and the stigmas are not ready for pollination at the same time. When the stamens shed their pollen before the stigma is ready to receive it, the flower is said to be *proterandrous* (*e.g.* Daisy-family, Mallow). But when the stigma is ripe before the anthers are able to dehisce, the flower is described as *proterogynous.*

(iii.) Sometimes *the pollen has no fertilising effect on the ovules of the same flower*, so that when the stigma receives pollen from the same flower no seeds result (*e.g.* some Orchids).

(iv.) *The relative arrangement of the parts of the flower*, in some cases, prevents the pollen reaching the stigma of the same flower (see Pansy, on page 129; also see the long-styled form of Primrose, on page 150).

Cross-pollination by the aid of the wind—Wind-pollinated flowers.—In the case of ordinary flowering plants with flowers raised above ground or above the water, it is necessary for pollen to be transported through the air if the flowers are to be cross-pollinated. The pollen has no power to move unaided, only rarely does the plant itself assist by throwing the pollen violently (as in the Stinging Nettle); so that the pollen is necessarily conveyed from one plant to another by the aid of the wind or by the agency of animals. Flowers which are cross-pollinated by the aid of the wind are described as *wind-pollinated flowers.* Flowers which are cross-pollinated by the agency of animals are *animal-pollinated*: in Britain the only animals which are of importance in effecting the cross-pollination of flowers are insects: hence we speak of *insect-pollinated* flowers.

As examples of wind-pollinated flowers, we may mention Hazels, Poplars, and Grasses (see pages 109-112, 182-184). In regard to these wind-pollinated flowers, it will be noted that:

(i.) They are small, inconspicuous, and unscented.

(ii.) They have no nectaries.

(iii.) Their pollen is powdery, and not sticky.

(iv.) The anthers are attached to long filaments, and hang freely out of the flowers, or are arranged in easily movable inflorescences, so that the pollen is readily shaken out by a gentle breeze.

(v.) The stigmas are well-developed, and often feathery or thread-like, so that a large surface is exposed to receive any pollen blown thither by the wind.

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

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(vi.) Usually a large amount of pollen is produced.

These characters serve to illustrate the general peculiarities of wind-pollinated flowers. The wind-pollinated flowers of the Pine differ in that the pollen is blown on to the open carpels, but here the open crevices of the carpellary cone must be regarded as exposing the large surface to receive the pollen.

Cross-pollination by the agency of insects — Insect-pollinated flowers.—The Buttercup, Wallflower, Poppy, Pea, and Hyacinth all possess flowers which are cross-pollinated by the agency of insects. They serve to illustrate the general features of insect-pollinated flowers.

(i.) They are brightly coloured or scented.

(ii.) They usually possess nectaries, for the sake of whose honey insects visit them; occasionally (*e.g.* Poppy, Potato) insect-pollinated flowers do not manufacture honey, but supply their insect-visitors with food in the form of pollen.

(iii.) The pollen-grains, in place of being powdery, are usually sticky, so that they adhere to the bodies of insects.

(iv.) There is a certain correspondence between the positions of the anthers and the stigmas of the flowers.

(v.) The stigma is not feathery or pencil-like, but, as a rule, is relatively small.

These general statements are liable to exceptions; some insect-pollinated flowers are inconspicuous, and, so far as we can smell, are also scentless (*e.g.* Virginia Creeper). Insect-pollinated flowers have one advantage over wind-pollinated flowers; they are pollinated by agents which move in definite directions—namely, from flower to flower. Wind-pollinated flowers are pollinated by the wind, which blows the pollen in any direction; so that for every pollen-grain which reaches the flower of another individual-plant of the same kind, millions of other pollen-grains fall to the ground and are wasted. The insect-pollinated flower can afford to manufacture less pollen, and is more economical than a flower pollinated by the aid of the wind. The various colours and scents of flowers not only serve to attract insects, but they assist the insect in identifying the flower it wishes to visit. For example, we often see a bee confining its visits to one kind of plant—say a Poppy—during the whole of a morning. The fact that honey is sipped by insects visiting the flowers, together with the fact that wind-

pollinated flowers have no nectaries, denotes that the nectaries serve to entice insects.

The insects which visit flowers in order to obtain honey or pollen, belong to the families of the Beetles, Flies, Bees (including Wasps and Humble-bees), and Butterflies (with Moths). The majority of Flies and Beetles have very short tongues, and are not intelligent, so that they can only obtain such honey as is easily accessible; the hover-flies form an exception to this rule, for they possess long tongues. The Bee-family provides the most important pollinating insect-agents; the simplest members have only short tongues; but many species of bees and wasps are clever, and possess long tongues, consequently they are able to discover and obtain honey which is carefully concealed and deeply placed. Finally, many Butterflies and Moths, with tongues even longer than those of humble-bees, can reach honey which is so deeply placed at the bottom of long tubes as to be inaccessible to the latter insects.

We find that flowers of different shapes and tints do not receive equal attention from all these families of insects. Flowers like those of the Parsley-family, with freely-exposed honey (fig. 183), or the Buttercup, with honey scarcely concealed (fig. 61), receive relatively more visits from the short-tongued insects—flies and beetles—than do flowers with deeply-concealed honey (*e.g. Geranium*, fig. 165). Opposed to these flowers which are suited to the requirements of many kinds of insect-visitors are others which are specially adapted to receive certain particular classes of insects. The flowers of the Pea, Vetch, Clover, and Violet have their honey so well concealed that only clever insects with tolerably long tongues can reach the nectaries (figs. 96, 158); they are pollinated by the agency of bees, and are specially adapted to receive their visits, and may therefore be termed "Bee-flowers." The Monkshood (fig. 151) and Foxglove (fig. 193) are similarly "Humble-bee flowers" (see pages 120, 157). Finally, Pinks and the Honeysuckle are adapted to receive Butterflies and Moths respectively: their honey is not fully accessible to bees.

Comparing the actinomorphic flowers of the Buttercup with the zygomorphic "Bee-flowers" mentioned, it will be noted that the buttercup-flower may be entered from any side, and the visiting insect may crawl about in the flower and receive

pollen on various parts of its body. On the contrary, the "Bee-flower" is so constructed that its honey cannot be obtained unless the insect visits in a certain special manner; the consequence is that the visiting insect receives pollen on a certain definite region of its body, and may unerringly convey that pollen to the stigma of the flower next visited. For instance, in the pea-flower it is the under-surface of the bee's body which comes into contact with the pollen and stigma; in the Foxglove, it is the back of the humble-bee which is pollen-dusted and meets with the stigma. This arrangement in these "Bee-flowers," therefore, not only allows the flower to economise in pollen, but it also places the pollen and honey in a position of greater safety in regard to the injurious action of rain and the inroads of marauding insects. For further illustrations, refer to Ranunculaceæ (p. 121), Papilionaceæ (p. 138), Labiatæ (p. 155), Scrophulariaceæ (p. 157), Caprifoliaceæ (p. 160), Araceæ (p. 180).

SELF-POLLINATION.

Although in the case of many plants cross-pollination leads to the production of better seeds, or more seeds, than self-pollination, yet some plants produce quite as many seeds, and those of as good quality, by self-pollination as by cross-pollination. Cross-pollination has this advantage over self-pollination, that it frequently affords a better crop of seeds. But self-pollination is superior in one respect, it is easily secured and rendered certain: the pollen simply has to come into contact with a stigma which is ready and close at hand. The self-pollinated plant is not dependent on the presence of another individual-plant of the same kind in the immediate neighbourhood: furthermore, it neither demands the attendance of special insects nor the influence of wind in a certain direction to carry the pollen to another individual. Many flowers are self-pollinated, either spontaneously or by the agency of insects. Insects wandering over the Buttercup-flower frequently effect self-pollination. In *Malva rotundifolia* (see page 134), and in some members of the Daisy-family, the stigmas curl down until they reach the pollen-laden anthers, so that the flower spontaneously pollinates itself. The flower of the Poor-man's Weather-glass (*Anagallis*), if it

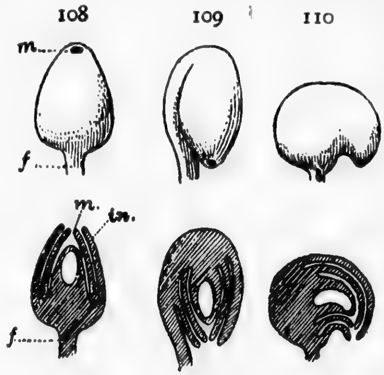
be not cross-pollinated within the first three days, remains permanently closed, and its anthers, coming into contact with the stigma, effect self-pollination. The Pansy (see page 129) has two kinds of flowers, the large variegated ones, which are cross-pollinated, and smaller ones, similar in shape, which remain closed and pollinate themselves. Finally, the Violet and the Woodsorrel, in addition to possessing their familiar conspicuous flowers, which are cross-pollinated, also have minute green and bud-like flowers of quite different form. These latter never open: they are peculiar self-pollinating or *cleistogamic* flowers.

CHAPTER XII

OVULE—FERTILISATION—SEED—FRUIT

OVULE.

An ovule (figs. 108, 111) is a more or less egg-shaped body attached to the placenta by means of a stalk—the *funicle* (*f*). The main body of the ovule consists of a central egg-shaped mass — the *nucellus* — which is surrounded by one or two coats — the *integuments* (*in*). Each integument is attached by its base to the nucellus, but elsewhere it surrounds the nucellus like a narrow-mouthed bag, which is open at the top. The opening at the top of the integument or integuments is the *micropyle* (*m*); it allows free communication between the nucellus and the chamber of the ovary. In the nucellus itself, near the micropyle, there is a minute clear space. This is in reality a closed bladder, and is termed the *embryo-sac.*



Figs. 108-110.—Ovules.
Figs. 111-113.—Vertical sections through ovules.

There are three common types of ovules, whose forms are best explained by the figures given. (1) An *orthotropous* ovule is one in which the stalk (funicle) is in the same straight line as the straight nucellus (figs. 108, 111). (2) An *anatropous* ovule is one in which the nucellus itself is straight, but is inverted, and consequently appears to be attached by its side

to the funicle (figs. 109, 112). (3) A *campylotropous* ovule is one in which the nucellus is itself curved; often it is kidney-shaped (figs. 110, 113).

FERTILISATION AND CHANGES IN THE OVULE.

When a healthy pollen-grain reaches a suitable stigma (fig. 114 *sg*) it germinates by sending a slender tube (*pt*) down the style. The end of this pollen-tube eventually enters the micropyle (*m*), and comes into contact with the nucellus close to the top of the embryo-sac (*es*).*

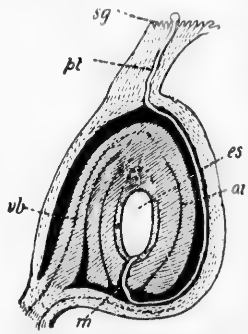


Fig. 114.—Vertical section through a carpel and an anatropous ovule, showing the pollen-tube entering the micropyle.

The consequence of fertilisation is that the *ovule grows and becomes a seed* (compare figs. 114 and 115). The most important change in the ovule is that a minute new plant—the embryo—develops inside the embryo-sac. The embryo-sac grows and becomes, wholly or partially, filled with endosperm, which surrounds the embryo. This endosperm may be present still in the seed, and the seed is said to be *endospermic*—*e.g.* Grass and Violet (figs. 118, 158). Or the endosperm formed in the ovule may be gradually absorbed by the growing embryo, so that in the ripe seed there remains no trace of it: the seed is then said to be *non-endospermic*—*e.g.* Bean and Wallflower (fig. 116). In most flowering plants, whilst the embryo-sac, the contained endosperm, and the embryo are grow-

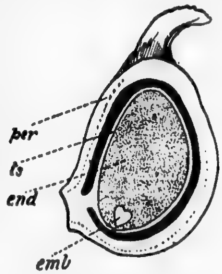
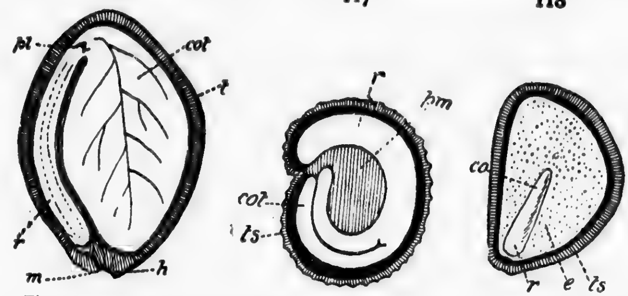


Fig. 115.—Vertical section through a fruit of the Buttercup, with one anatropous seed: *per* = pericarp; *ts* = testa; *end* = endosperm; *emb* = embryo.

* This process can only be followed properly by the aid of a compound microscope. In a few Angiosperms the pollen-tube does not enter by the micropyle, but pushes its way through the substance of the ovule till it reaches the embryo-sac. In the Pine and Gymnosperms the pollen-grain itself reaches the micropyle and then sends out a tube.

ing, the nucellus is being absorbed by them, and no trace of it remains in the mature seed. In such cases the whole of the seed within the testa represents the embryo-sac and its contents. In some plants the nucellus is not entirely absorbed, but persists and forms an endosperm-like layer within the

116 117 118



Figs. 116-118.—Vertical sections of seeds: h = scar on seed; m = micropyle; t, ts = testa; e = endosperm; pm = perisperm; co, cot = cotyledon; pl = plumule; r = radicle. Fig. 116.—Wallflower. Fig. 117.—*Stellaria.* Fig. 118.—*Iris.*

testa: this is termed the *perisperm*—*e.g.* *Stellaria* (fig. 117). The testa is formed by the growth and hardening of the integument or integuments, and the micropyle of the seed represents the micropyle of the ovule. The funicle or stalk of the seed is identical with the funicle of the ovule. The subjoined table represents the corresponding parts in the ovule and seed:—

	Ovule	=	Seed
(*a*)	The contents of the embryo-sac	=	Embryo and Endosperm.
(*b*)	Nucellus	=	Perisperm.
(*c*)	Integuments . . .	=	Testa.
(*d*)	Micropyle . . .	=	Micropyle.
(*e*)	Funicle	=	Funicle.

As examples of different types of seeds, the following may be cited as occurring in both Monocotyledons and Dicotyledons.

(i.) *No endosperm, no perisperm*: Pea, Bean, Wallflower, Mustard, Pear, Apple, Hazel, Oak, and Chestnut (figs. 1, 116).

(ii.) *Endosperm, but no perisperm*: Buttercup, Violet, Mallow, Castor Oil plant, and Grasses (fig. 118).

(iii.) *Perisperm with scarcely a trace of endosperm*: *Stellaria* (fig. 117).

Outgrowths on Seeds.—The Violet and the Spurge have each a little lump near the micropyle (fig. 158). Many outgrowths are concerned with the scattering of the seed: for instance, the long silky hairs or the seeds of Poplars, Willows, and Willow-herbs, facilitate the dispersal of the seeds by the wind.

FRUIT.

The consequences of fertilisation are not confined to the ovules; the carpels, and frequently other parts, of the flower are stimulated into vigorous growth, whereas the remaining parts

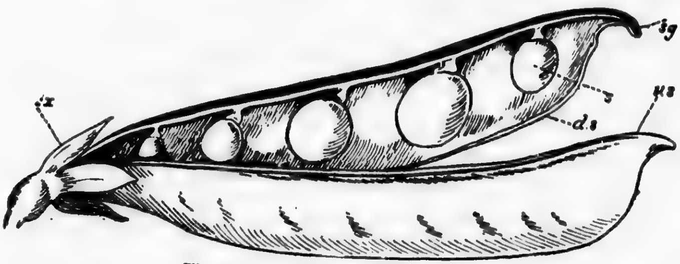


Fig. 119.—Fruit (legume) of Garden Pea.

wither and fall off more speedily than they would have done had fertilisation not taken place. *That portion of a single flower which persists after fertilisation until the seeds are ripe is termed the* **fruit.** There is one part of the flower which invariably persists — the ovary (or ovaries) — this remains to form a protective case round the ripening seeds. Obviously the receptacle, or a portion of it, also remains. The corolla and stamens almost always wither soon and fall, consequently they play no part in the formation of the fruit; whereas the calyx not infrequently persists.

The Pea (or Bean, or Clover) may be selected as having one of the simplest of fruits. Its ovary, composed of one carpel, enlarges and becomes the familiar pea-pod (fig. 119), and constitutes the fruit inside which are the seeds. The

Wallflower is slightly more complicated, in that the ovary is syncarpous, being composed of two carpels; but in this flower, as in the Pea, it is the single ovary alone which, by its growth, gives rise to the single fruit (fig. 120). The Buttercup differs from the two preceding examples in that every flower has a number of separate ovaries, each representing one carpel. Each ovary enlarges and eventually encloses one seed (fig. 115). This flower thus gives place to a number of apocarpous seed-containing vessels, each similar to the pea-pod in so far as it consists of a single ripened carpel. We can, therefore, divide fruits into two groups: (i.) **Simple fruits,** produced by a single ovary which is composed of one (*e.g.* Pea) or more carpels (*e.g.* Wallflower). (ii.) **Compound fruits,** produced by a number of apocarpous carpels in one flower (*e.g.* Buttercup). Thus the fruit of a Buttercup is a compound fruit and consists of a number of simple fruits.

The external wall of the chamber, or chambers, of a simple fruit is termed the **pericarp.** In the case of the simple fruits already mentioned, the pericarp is derived solely from the carpels; it is the original wall of the ovary, which has grown. But if we consider a simple fruit derived from a single inferior ovary (*e.g.* Honeysuckle, Parsley, Yellow Flag, Orchid), the wall of the fruit represents part of the receptacle as well as portions of the carpels (see p. 75).

Again, if we examine a ripened (fertilised) Dandelion-head (fig. 129), we shall see that it consists of a number of simple fruits. Every one of these is formed by the growth of a single inferior ovary, each of which belongs to a separate flower. This Dandelion-head is formed as a result of the fertilisation of a number of flowers. A fruit is formed from one flower, consequently the Dandelion-head is not a fruit, not even a compound fruit: it is a collection of fruits, or an *infructescence.*

Comparing the behaviour of the pericarp of the simple fruits of the Pea, Wallflower, Buttercup, and Dandelion, we see that the pericarp of the first two gapes open, or *dehisces,* when it is ripe, so that the carpels are freely open; whereas, on the contrary, the fruits of the last two do not open of their own accord. If we now examine the fruit of a Parsley-plant (or any Umbellifer), we note that it is formed by a single inferior, two-chambered ovary, composed of two carpels. When the fruit

is ripe the two carpels separate, but do not open. We may, therefore, divide simple fruits into three groups:—(1) **Dehiscent** fruits, the carpels of which open spontaneously. (2) **Indehiscent** fruits, the carpels of which remain closed, and, if syncarpous, do not separate. (3) **Separating** fruits, which are always syncarpous, and the carpels of which separate without opening.

Again, comparing the fruits of the Pea, Wallflower, and Buttercup with those of the Honeysuckle, Gooseberry, and Currant, the first three have a thin, *dry*, hard or brittle pericarp; whereas the second three possess a fresh, more or less *fleshy* or *succulent* pericarp. We may, therefore, further classify fruits into (1) **dry** fruits; (2) **fleshy** or **succulent** fruits.

CLASSIFICATION OF SIMPLE FRUITS

DEHISCENT FRUITS (Carpels opening)

A. DRY (DEHISCENT).

(i.) *One-carpellary* (composed of one carpel).

(*a*) Opening down the ventral suture only, containing one or more seeds (*e.g.* Pæony, Winter-Aconite) = **Follicle.**

(*b*) Opening down the two sutures, dorsal and ventral, and containing one or more seeds (*e.g.* Pea, Bean, Clover) = **Legume.**

(ii.) *Two-carpellary* (composed of two carpels).

(*a*) The two carpels separate as two valves, commencing from below upwards, and leave the seeds attached to a persistent frame-like parietal placenta which is termed the *replum.* The chamber of the fruit may (*e.g. Cruciferæ*) be divided into two chambers by a thin septum which spans the space between the two parietal placentæ and persists in the fruit (fig. 120); or there may be no such septum, so that the ovary is one-chambered as is the fruit—*e.g. Chelidonium* (fig. 121). A number of seeds are present in the fruit = **Siliqua.**

Fig. 120.—Siliqua of Wallflower: *re* = replum; *fs* = false septum; *o* = seed; *v* = valve; *sg* = stigma.

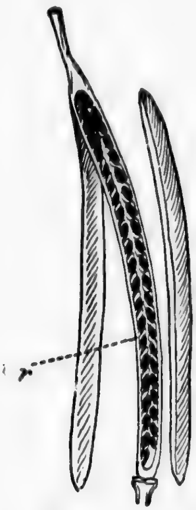


Fig. 121.—Siliqua of *Chelidonium*: *r* = replum.

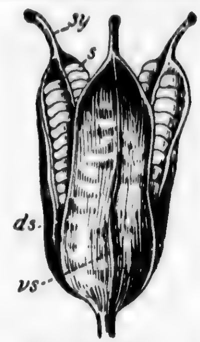


Fig. 122.—Capsule of *Iris* dehiscing along three dorsal sutures (*ds*); *vs* = ventral suture; *s* = seed.

Fig. 125. — Capsule of *Anagallis* dehiscing transversely: *c* = calyx; *s* = seeds; *sg* = style.

Fig. 123. — Capsule of Foxglove dehiscing along two ventral sutures, and leaving the seeds attached to the axile placenta (*pl*); *sy* = style; *cx* = calyx.

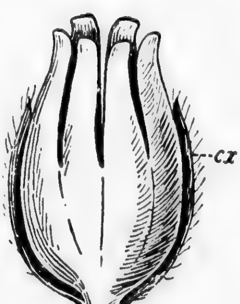


Fig. 124. — Capsule of *Stellaria media* dehiscing for a certain distance along three dorsal sutures and three ventral sutures; *cx* = calyx.

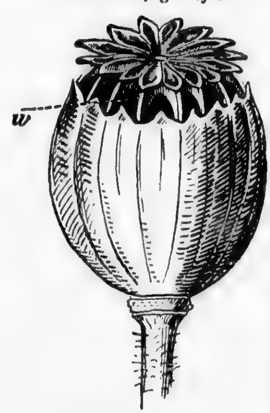


Fig. 126. — Capsule of Poppy dehiscing by pores (*w*).

The siliqua is typically pod-like in shape, but a short broad form is often distinguished as a *Silicula* (*e.g.* Shepherd's Purse).

(iii.) *Two or more carpels* = **Capsule.**

(*a*) Usually a dry dehiscent fruit formed by more than two combined carpels, dehisces *longitudinally*, and causes the pericarp to split into a number of valves. The splits may descend from the apex to the base of the fruit, or they may be merely confined to the upper part, in which case the separate valves are tooth-like (*e.g.* *Cerastium*, Primrose). Longitudinally dehiscing capsules are of four kinds.

(α) Splitting along the ventral sutures.

(β) Splitting along the dorsal sutures (*e.g.* Violet, fig. 158; *Iris*, fig. 122).

(γ) Splitting along the ventral sutures, and separating from the partition walls of the capsule so as to leave the seeds attached to a middle axial column (*e.g.* Foxglove, fig. 123).

(δ) Splitting for a certain distance along both dorsal and ventral sutures, so that there are twice as many valves as there are carpels (especially in capsules with tooth-like dehiscence) (*e.g.* *Stellaria media*, fig. 124).

(*b*) Capsule with *transverse* dehiscence. The top of the capsule separates like a lid (*e.g.* Poor-man's Weather-glass, fig. 125).

(*c*) Capsule opening by a number of little holes or *pores* in the pericarp (*e.g.* Poppy, fig. 126).

(*d*) Capsule opening *irregularly*.

B. FLESHY (DEHISCENT).

Some *follicles* are soft and green when they dehisce. The green succulent *capsules* of the Balsam open violently, and fling their seeds to some distance. The capsule of the Woodsorrel has a soft pericarp, which splits open and allows the seeds to

be violently ejected. The Horse-Chestnut capsules are succulent. The Walnut-fruit is not a nut: it is a stone-fruit, the outer fleshy layer of which bursts irregularly; its so-called nut is therefore a "stone."

INDEHISCENT FRUITS

Fig. 127.—Achene of Sunflower.

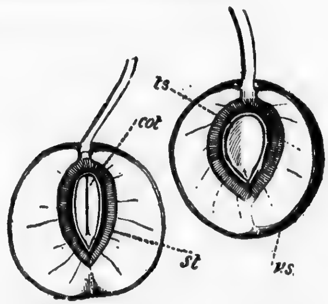


Fig. 128.—Vertical sections of the drupe of Cherry: in the right-hand figure the fruit is cut vertically through the ventral suture (*vs*) and dorsal suture: in the left-hand figure the fruit is vertically cut in a plane at right angles to the preceding one: *st*=stony layer of pericarp; *ts*=testa of seed; *cot*=cotyledon.

A. DRY (INDEHISCENT).

One-Seeded.

(1) Pericarp stone-like (*e.g.* Hazel, fig. 138). =**Nut.**
(2) Pericarp leathery, or hard skin-like.
  (α) Pericarp not adhering to the testa (*e.g.* Buttercup, fig. 115; Daisy-family, figs. 127, 212). =**Achene.**
  (β) Pericarp adhering closely to the testa, or the testa absent (*e.g.* Grains of Grasses, Wheat, fig. 28). =**Caryopsis.**

B. FLESHY (INDEHISCENT).

(1) The inmost layer of the pericarp is stone-like =**Drupe.**
  (*a*) The outer layer of the pericarp of a drupe is like a thin "skin," the middle layer is usually soft and juicy, and the inmost layer is very hard

and stone-like. The simplest drupes are composed of one carpel, with one stone enclosing one seed (*e.g.* Cherry, fig. 128, Plum, Apricot). The most complicated drupes are syncarpous, and have several stones, because the walls of each of the ovary-chambers has become separately changed into a stone with one seed inside it. It must be noted that the stones (*e.g.* Hawthorn) of stone-fruits are not seeds. A seed is produced from an ovule only, whereas the hard stone of a drupe is formed by a layer of the ovary-wall.

(*b*) The pericarp is soft and fleshy throughout (*e.g.* Grape, Gooseberry, Currant, Orange, Cucumber) = **Berry.**

(*c*) The fruit of the pear and apple is quite peculiar, and is termed a **Pome**. The component five carpels are fused with the hollow receptacle by their outer faces, hence the gynæcium is inferior (fig. 178). The carpels are also combined with one another by their sides, but may be free towards their centres (ventral sutures), thus the gynæcium is only incompletely syncarpous (fig. 179). In the fruit a parchment-like membrane forms round each chamber, just as stones may form round the several chambers of a stone-fruit, whilst the rest of the pericarp grows vigorously and remains fleshy (figs. 180, 181). The seeds are contained in the five parchment-walled chambers (fig. 182). The pome is intermediate between a berry and a stone-fruit, also between a compound and a simple fruit.

SEPARATING FRUITS (SCHIZOCARPS)

These all possess more than one carpel. The constituent carpels separate as closed one-seeded chambers.

(*a*) The fruit separates into as many closed one-seeded one-chambered parts as there are carpels. Each part represents a closed carpel, and is termed a **mericarp**

(*e.g.* two-carpellary fruits of the Parsley-family, fig. 185, and Sycamore) or a **coccus** (if the ovary consists of more than two carpels, *e.g.* Mallow, fig. 164) = **Schizocarp.**

(*b*) The two-carpellary fruit is divided into four one-chambered one-seeded parts which separate as little "nuts." Each "nut" therefore represents half a carpel (*e.g.* fruits of the *Labiatæ*, and many *Boraginaceæ*).

COMPOUND FRUITS.

The compound fruit may possess a number of follicles (*e.g.* Pæony, Winter Aconite), of achenes (*e.g.* Buttercup, Rose, fig. 170, Strawberry, fig. 172), of drupes (*e.g.* Blackberry, fig. 175, Raspberry), inserted on a receptacle. But obviously it cannot possess a number of siliquæ or capsules, because these are always syncarpous fruits.

DESCRIPTIONS OF COMPLETE FRUITS.

The classification of fruits so far given refers only to the nature and behaviour of the pericarp. A few examples will illustrate the application of this classification to complete fruits.

(1) Pea: the fruit is simple (legume) and is the ripened carpel.

(2) Honeysuckle: the fruit is simple (berry), is the ripened inferior ovary, and therefore includes the receptacle.

(3) Dandelion: the fruit is simple (achene), and consists of the ripened inferior ovary (carpels and receptacle) and pappus.

(4) Raspberry: the fruit is compound; the simple fruits are drupes (= carpels) inserted on a receptacle, which also bears a persistent calyx.

(5) Strawberry: the fruit is compound, and consists of many achenes (= carpels), and a large fleshy receptacle bearing a calyx with an epicalyx.

(6) Rose: the fruit is compound, consisting of many achenes (= carpels) attached to and concealed in a hollow receptacle which bears a persistent calyx.

CHAPTER XIII

THE DISPERSAL OF SEEDS, AND A SUMMARY WITH REGARD TO THE FLOWERS

In one season a single plant, say a Foxglove, may produce thousands of seeds. If every one of these seeds is to be afforded an opportunity of developing into a mature plant, means must be provided to enable the seeds to reach suitable spots at some distance from the mother-plant. The seeds of flowering plants are conveyed through the air in the same manner as the pollen, in so far that they are either violently ejected (*e.g.* Balsam, *Oxalis*), or are carried by the wind (*e.g.* Dandelion), or borne by animals (*e.g.* Rose, Cherry, *Galium*).

Fig. 129.—Right-hand figure is a vertical section of infructescence of Dandelion: *br*= involucre. Left-hand figure is a vertical section of a single fruit (achene) with a pappus (*pp*) on a long beak; *pc*=pericarp; *ts*=testa of the seed; *cot*=cotyledons; *r*=radicle.

Explosive fruits are not common. The capsule of the Violet opens into three boat-shaped valves, each containing a double row of smoothly-polished seeds. The sides of the boat-shaped valves contract as they dry, and fling out the seeds. To understand this mechanism, we have only to remember the manner in which an orange-pip springs out when squeezed between two fingers.

Dispersal by the wind.—To facilitate dispersal by the

agency of the wind, the fruits or seeds are very small; or they oppose a large surface to the wind. The large surface may be merely due to the flattened form of the fruit or seed, or it may be caused by the possession of wings or tufts of hair. It is to be noted that when fruits (or their carpels in the case of schizocarps) are closed and indehiscent, they (or the mericarps) are the parts scattered, and adapted to aid dispersal; the seeds in this case are passively borne inside the fruits. But if the fruit dehisces, or is open (*e.g.* Gymnosperms), the seeds are the parts scattered, and, as a rule, it is they and not the fruits which are adapted for transference to distant spots. The following table shows the corresponding mechanisms, or forms, in fruits and seeds to aid dispersal by the wind:—

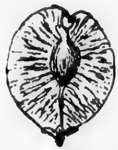


Fig. 130.—Samara of Elm.

Mechanism or Form.	SEEDS DISPERSED (Fruits dehiscent or open).	FRUITS DISPERSED (Fruits indehiscent or separating).
1. Minute size.	Orchid (Fruit = capsule).	Nutlets of Labiatæ.
2. Flattened form.	Wallflower (Fruit = *siliqua*).	Mericarps of many *Umbelliferae* (fig. 185).
3. Wings.	Scotch Pine (is a *Gymnosperm*), fig. 67.	Samaræ (fig. 130) of Elm, Birch, and Sycamore.
4. Tufts of hair.	Willow, Poplar, Willow-herbs (Fruits are capsules).	The achenes of many Compositæ (Dandelion, etc.) with a *pappus* (fig. 129). Achene of *Clematis* with a hairy style.

Dispersal by clinging to Animals.—Many fruits possess hooks, or rough or sticky surfaces, which cause them to adhere to animals which happen to brush against them. It is usually the fruit, not the seed, which possesses hooks, etc. As examples may be cited, the "burrs" of the infructescences of many Compositæ (Daisy-family), the hooked achenes of *Geum*, and the fruits of *Galium* (Goose-grass).

Seeds dispersed by being transported inside Animals.—It is to be noted that when the seeds or fruits are scattered by

the wind, or by clinging to animals, the fruits are dry, whereas seeds or fruits which are dispersed by being carried inside animals are usually possessed of conspicuous and fleshy coats, which invite animals to notice and eat them. The fruits being eaten, the seeds are protected by an indigestible stone (in drupes) or testa (in berries and Gymnospermous fruits), and pass through the body of the animal uninjured. When the fruit is indehiscent it is usually the pericarp which is succulent and invites the animals which effect the dispersal of the fruit. When, on the other hand, the carpels are open, as in Gymnosperms and dehiscent fruits, the seed is often brightly coloured, and may have a succulent inviting outgrowth (the *aril*).

SEEDS DISPERSED.	FRUITS DISPERSED.
(*a*) *Fleshy aril*— Seeds of Yew (Gymnosperm) with bright-red fleshy "aril," distributed by birds.	(*a*) *Fleshy pericarp*— Drupes of Cherry, Blackberry, Raspberry, distributed by birds. Larger drupes of plums, etc., distributed by larger animals (Mammals). Berries of Mistletoe, Currants, distributed by birds. (*b*) *Fleshy or coloured receptacle*— Rose-hip, Strawberry, both distributed by the agency of birds.

Protection of the embryo in the seed.—The embryo and food-substance inside the testa require protection against climatic influences which would hasten their disorganisation and decay, and against attacks on the part of animals and fungi. The embryo and food-substance are therefore protected by a firm hard coat. When the fruit is dehiscent and the seeds travel naked, the testa is thick and strong (*e.g.* Wallflower, Bean). When the fruit is dry, indehiscent or separating, the seed is protected by the pericarp, and there is no necessity for the testa to be so thick—in fact, it may be quite imperceptible or absent (*e.g.* Grasses). Finally, in fleshy indehiscent fruits the stony layer of the pericarp of drupes protects the embryo, and the testa is thin, whereas in berries there is no stony layer, so that the testa of the seed must be well developed

in order to withstand the action of the digestive juice of animals which eat the fruits.

SUMMARY OF THE FUNCTIONS OF PARTS OF FLOWERS, FRUITS, AND SEEDS.

1. The **calyx** usually protects the young flower bud (*e.g.* Poppy). It may also serve as a means of attracting insects by its colour (*e.g.* Clematis), or act as a factory (*e.g.* Mallow), or as a receptacle for honey (*e.g.* Wallflower). Sometimes the calyx aids in the dispersal of the seeds by the agency of the wind (*e.g.* pappus of Compositæ).

2. The **corolla** serves to attract insects which will effect cross-pollination. It may further bear nectaries (*e.g.* Buttercup).

3. The **andrœcium**.—The pollen pollinates the flower, and is indispensable for the production of seed. The anther manufactures the pollen. The filaments bring the anthers into the position which will lead to cross-pollination by wind or insects, or to self-pollination. As good examples, illustrating the fact that the length of the filaments is to be explained in accordance with the method of pollination, we have but to compare and contrast the flowers of the Primrose, of Grasses, and the cleistogamic flowers of the Violet. The time and direction of dehiscence also are related to the method of pollination; we note, for instance, the introrse dehiscence of the Violet and of Composites, the extrorse dehiscence in the Buttercup when the flower opens.

4. The **gynæcium**.—The embryo-sac in each ovule is the region in which the embryo and its food (endosperm) arise. The ovary protects the ovules. The stigma receives the pollen-grains. The style raises the stigma to the proper height so as to bring about cross-pollination or self-pollination. The size, shape, and time of ripening of the stigma and style bear relation to the method of pollination (see Grasses, Compositæ, Violet).

5. **Sugar**.—Sugar is excreted in flowers in order to attract insects which will effect cross-pollination. Sugar is manufactured in many fruits, and is responsible for their sweetness of flavour, in order to allure animals (mainly birds in this country) which will disperse the seeds.

6. **Pericarp**.—The pericarp protects the seeds and often facilitates their dispersal. Often it is brightly coloured so as to attract the notice of animals. It may or may not dehisce.

7. The **testa** serves to protect the embryo and food-substance of the seeds. Consequently it is thin and delicate when the seeds are adequately protected by the pericarp.

8. *Wings*, *hooks*, and *hairs on seeds or fruits* serve to facilitate the dispersal of the seeds. Sometimes the hooks or spines may also aid in protecting the fruits against animals which would eat them and destroy the seeds.

PART II

CLASSIFICATION OF ANGIOSPERMS

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CHAPTER XIV

CLASSIFICATION

WHEN a number of plants are so closely alike that they obviously may be the offspring of one original parent, they are said to be a number of *individuals* all belonging to one *species*. But if two or more plants are very similar, yet exhibit certain constant slight distinctions, they are described as being different species of one *genus*. For example, in English meadows there are to be found three common kinds of Buttercups—the Bulbous Buttercup, the Creeping Buttercup, and the Meadow Buttercup. As they possess so many characteristics in common, they are included in one genus, *Ranunculus*; but as they each display certain characteristics peculiar to themselves, they receive distinct species-names, and are known as *Ranunculus bulbosus*, *R. repens*, and *R. acris* respectively. When the divergences between two or more plants are more considerable, they are referred to different genera. For example, the Clovers are included in the genus *Trifolium*. Comparing the various genera thus constituted, they exhibit amongst themselves both resemblances and dissimilarities. Those genera which are sufficiently alike are grouped together to form a *family* or *order*; so that all genera are included in certain orders. Thus the Buttercups (*Ranunculus*) and the Marsh Mallow (*Caltha*) are included in one order, the Ranunculaceæ; whilst the Clovers (*Trifolium*) and Vetches (*Vicia*) belong to another order, the Leguminosæ. In like manner the families may be grouped together to form cohorts, then series, then sub-classes, and finally classes; but this statement will be more easily understood after glancing through the following scheme of classification of some of the Angiosperms:—

ANGIOSPERMS.

CLASS I.: **Dicotyledons.**—Seedling has two cotyledons. Leaves net-veined. Floral leaves in fours and fives.

CLASS II.: **Monocotyledons.**—Seedling has one cotyledon. Leaves parallel-veined. Floral leaves in threes.

CLASS I.: **DICOTYLEDONS**

SUB-CLASS I.: APETALÆ. Petals absent.

1. *Cupuliferæ.* Flowers epigynous diclinous. ♂ flowers in catkins. Fruit indehiscent one-seeded. Trees or shrubs.
2. *Salicaceæ.* Flowers hypogynous diclinous. ♂ flowers in catkins. Fruit dehiscent with many seeds. Trees or shrubs.

[3. *Euphorbiaceæ.** Flowers diclinous. In the fruit the three (sometimes two) carpels separate and open; one or two seeds in each chamber.]

SUB-CLASS II.: POLYPETALÆ. Corolla polypetalous.

I. **Thalamifloræ.**—Flowers hypogynous without a well-developed disk.

(a) *Gynæcium apocarpous.*

4. *Ranunculaceæ°.* Stamens indefinite.

(b) *Ovary syncarpous with parietal placentation.*

5. *Papaveraceæ.* Flowers actinomorphic. Sepals and petals in twos or threes. Stamens indefinite.
6. *Fumariaceæ.* Flowers zygomorphic. Sepals and petals in twos.
7. *Cruciferæ°.* Flowers actinomorphic. Sepals and petals four each. Stamens two short and four long.
8. *Violaceæ.* Flowers zygomorphic. K5 C5 A5 G $\underline{(3)}$.

(c) *Ovary syncarpous. Placentation free-central.*

9. *Caryophyllaceæ°.* Flowers actinomorphic. Stamens ten or fewer.

* This is not the correct systematic position of the Euphorbiaceæ; but the family is placed here because it is easier for beginners to identify plants belonging to it when it is classed amongst the Apetalæ.

(d) *Ovary syncarpous. Placentation axile.*

10. *Malvaceæ.* Flowers actinomorphic. Stamens indefinite, filaments united and adhering at the base to the corolla. Anthers one-lobed.

II. **Discifloræ.** Flowers hypogynous

11. *Geraniaceæ*°. Flowers actinomorphic. Stamens 5 + 5 (obdiplostemonous) or five only. Fruit beaked with five chambers, each with one seed.
12. *Oxalidaceæ.* Flowers actinomorphic. Stamens 5 + 5 obdiplostemonous. Fruit five-chambered, with a number of seeds in each chamber.

III. **Calyciflorae.** Flowers perigynous or epigynous.

(a) *Perigynous usually. Gynæcium apocarpous.*

13. *Papilionaceæ*°. Flowers zygomorphic, papilionaceous, weakly perigynous. Stamens ten, with the filaments all combined, or one separate from the other nine. Carpel one.
14. *Rosaceæ*°. Flower actinomorphic. Stamens usually indefinite (rarely epigynous).

(b) *Epigynous. Gynæcium syncarpous.*

15. *Umbelliferæ*°. Flowers actinomorphic in umbellate inflorescences. K5 or 0 C5 A5 G $\overline{(2)}$. Fruit a schizocarp.

SUB-CLASS III.: GAMOPETALÆ. Corolla gamopetalous.

(a) FLOWERS HYPOGYNOUS. Gynæcium syncarpous.

(1) *Flowers actinomorphic* (stamens equal in number to the petals; corolla regular.)

16. *Primulaceæ*°. Placentation free-central. Stamens equal in number to the petals opposite to them.
17. *Convolvulaceæ.* Ovary two- (three-) chambered, with two ovules in each chamber; sometimes each chamber subdivided by a false partition into two halves, each containing one ovule. Twining herbs.
18. *Solanaceæ.* Ovary two-chambered, with several ovules in each chamber.

19. *Boraginaceæ.* Ovary four-lobed, four-chambered, with one ovule in each chamber. Fruit four nutlets.

(2) *Flowers zygomorphic* (stamens fewer than the petals; corolla irregular).

20. *Labiatæ*°. Ovary four-lobed, four-chambered, with one ovule in each chamber.
21. *Scrophulariaceæ.* Ovary two-chambered, with several ovules in each chamber.

(b) FLOWERS EPIGYNOUS. Gynæcium syncarpous.

22. *Caprifoliaceæ.* Ovary two- (three-) chambered. Leaves opposite.
23. *Compositæ*°. Inflorescence a capitulum. Anthers united. Ovary one-chambered, with one ovule.

CLASS II.: **MONOCOTYLEDONS**

I. PERIANTH PETALOID. Ovary syncarpous.

(a) *Flower actinomorphic* (perianth regular, ovary superior).

24. *Liliaceæ*°. Stamens six.

(b) *Flower actinomorphic.* Ovary inferior.

25. *Amaryllidaceæ.* Stamens six.
26. *Iridaceæ.* Stamens three.

(c) *Flower zygomorphic.* Ovary inferior.

27. *Orchidaceæ.* Perianth irregular. Usually only one anther present; it is gynandrous.

II. PERIANTH small or absent.

(a) Flowers ♀ ♂ on a spadix usually in a spathe.

28. *Araceæ.*

(b) Flowers usually ☿ in spikelets invested by chaffy bract-scales.

29. *Gramineæ.*

[It will be well for young beginners to confine their attention to those families which are specially marked with the sign ° in the above list.]

DICOTYLEDONS.

CUPULIFERÆ (Oak Family).

Trees or shrubs. Leaves simple. Monœcious. Staminate inflorescence usually a catkin. Flowers small, inconspicuous, apetalous. Perianth small, green, or absent. Carpels two or three (rarely four or six), syncarpous, inferior, usually with a two or three-chambered ovary; one or two ovules in each chamber. Fruit one-seeded, indehiscent, often a nut. Seeds without endosperm.

Type: HAZEL (*Corylus avellana*).

Vegetative Characters.—Shrub: the main stem breaks up into several larger branches a short distance above the ground. The main root present in the seedling grows only for a short time; it gives off several lateral roots which run horizontally close beneath the surface of the soil. These horizontal roots (or the base of the stem) frequently produce slender adventitious shoots—*suckers*—which grow vertically upwards. These shoots, in turn, can produce adventitious roots of their own at their bases, and subsequently may become disconnected from the mother-plant by reason of the decay of the connecting parts. Thus the Hazel may multiply by suckers (compare Raspberry canes and Rose trees).

Leaves alternate, arranged in two rows, or on vigorous suckers often in three rows, with small stipules which soon fall; the margin is twice-serrate. It will be noted that in the bud-condition the two halves of each leaf are folded together along the mid-rib: the one half of the leaf is slightly larger than the other and overlaps the latter in the bud.

On the approach of winter the stem ceases to elongate, and produces a terminal resting-bud. This resting-bud is clothed externally by leaves whose stipules are developed into scales, but which possess no lamina. Inasmuch as the leaves are ranked into two rows, their stipules naturally are arranged into two double rows. Consequently these bud-scales are arranged in pairs on opposite sides of the stem, and each pair of scales represents the two stipules of one leaf. The lateral (vegetative)

resting-buds are similar, but they have in addition two scale-like prophylls inserted below the remainder of the scales. Within the scales are hidden the young foliage-leaves. In February or March the plant blossoms before its vegetative buds unfold; when the latter become active their scales drop off after being forced apart by the growing stem and by the emerging foliage-leaves (figs. 6-11). Inasmuch as these scales were set close together, after they have fallen their scars form small groups; whereas the fallen foliage-leaves, having been separated by longer internodes, are represented by scars which are widely separated along the stem. Consequently, on parts of the stem which are from one to three years old, it is easy to recognise which portions bore scales. Each such group of scale-scars represents one winter. We can, therefore, tell the age of a tolerably young stem by counting the number of its groups of scale-scars. Thus, if we commence at the apex of a resting vegetative shoot, the portion of the stem which connects it with the first group of scale-scars represents one year's growth. Again, travelling farther down, that part of the stem which connects this first group of scars with the next lower group represents another (previous) year's growth, and hence it is two years old, and so on.

Inflorescences.—The stamens and carpels do not occur together in the same flowers. The staminate flowers are arranged in pendulous spike-like inflorescences — catkins. The carpellary flowers are grouped together in small bud-like inflorescences, which can be recognised by the tufts of red stigmas which protrude from their tips. Both kinds of inflorescences are borne upon certain axillary dwarf-branches. In order to understand the arrangement of these dwarf-branches, we will follow the growth of a vegetative bud which commences to sprout in spring. The bud opens, the stem emerges and grows during the summer, and bears foliage-leaves. In the axils of these leaves three varieties of buds arise—vegetative buds, buds enclosing the young carpellary flowers, and buds destined to grow out into branches bearing the staminate inflorescences. The first two forms of buds are externally similar; they are resting-buds, and remain dormant during the following winter. But the third type of bud grows out at once and develops into a dwarf-branch. This

branch has no foliage-leaves, but it bears on its basal parts a number of scales, whilst its terminal portion is a staminate inflorescence (catkin). In addition, lateral catkins may arise in the axils of one or two of the higher scales of this dwarf-branch. The scales soon drop off. Thus, when we examine the Hazel-trees flowering in February (see fig. 131), we find the staminate catkins (♂) are arranged, usually several together, on short branches of the previous year's stem: the catkins rest naked through the winter. The buds (♀) enclosing the carpellary flowers now show that they are not vegetative resting-buds, a tuft of red stigmas protrudes from their tips. These buds also stand laterally on a part of the stem which was formed in the previous year; also occasionally in the axils of the basal scales of the dwarf-branch which bears the catkins.

Staminate Inflorescence (fig. 131 ♂).—The inflorescence consists essentially of a number of bracts and axillary flowers, which are spirally arranged on a long axis. There is one flower in connection with each bract. Two prophylls (fig. 132, *pr*), representing the first two leaves on the flower-stalk, are present, but are fused with the bract (*br*), for no flower-stalk occurs. The **staminate flower** (fig. 132) con-

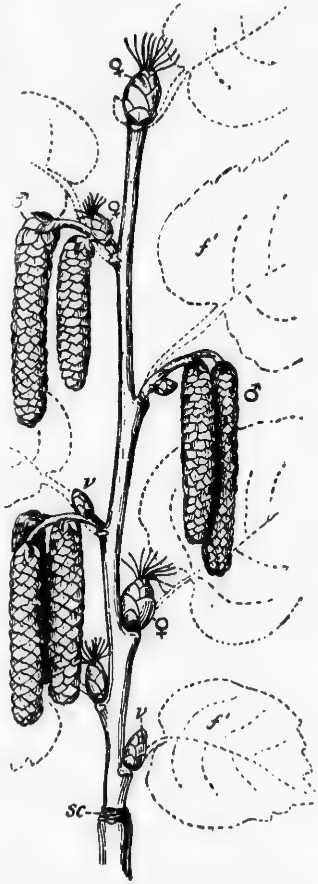

Fig. 131.—Shoot of Hazel bearing inflorescences. The stem from the scale-scars (*sc*) was produced in the previous year. The dotted leaves have fallen off; *v* = vegetative buds.

sists solely of four stamens, which are attached to the bract in place of being on a flower-stalk in the axil of that bract.

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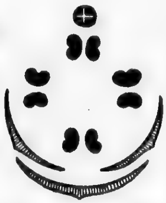

Fig. 132.—Staminate flower of Hazel inserted on bract (*br*), with which two prophylls (*pr*) are fused.
Fig. 133.—Diagram of ditto.

Each stamen is halved almost to the base of its filament, so that at first sight there appear to be eight stamens, each of which possesses only half a complete anther. The anther is crowned by a tuft of hairs.

The bud of the dwarf branch (fig. 134) which produces the carpellary inflorescence is often loosely described as being the inflorescence. The bud is really the commencement of a foliaged branch which terminates in an inflorescence; but the foliage-leaves do not unfold till after the flowering is over. On the axis of this bud the most external and lowest leaves are two prophylls; then succeed three to four pairs of scale-like stipules (*sc*), and within these two to four foliage-leaves. Thus so far the bud is like a vegetative bud; but above these foliage-leaves follows the true inflorescence. The **carpellary inflorescence** consists of four to eight spirally-placed bracts (*br*) with axillary flowers, which are borne on a shortened axis. In the axil of each bract (fig. 135) there stand the buds of two carpellary flowers, so that the whole inflorescence possesses eight to sixteen flower-buds. But only a few of the flower-buds develop into mature flowers. Each **carpellary flower** has a minute, indistinctly lobed, green perianth (*pe*), which is inserted on the

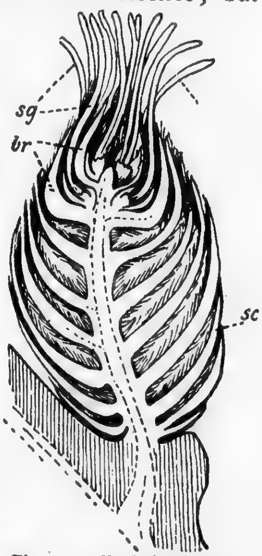

Fig. 134.—Vertical section of bud of Hazel terminating in a carpellary inflorescence.

ovary. The flower is therefore epigynous. The inferior ovary is two-chambered, and is surmounted by two long purplish-red thread-like stigmas (*sg*); thus the gynæcium consists of two

Fig. 135.—Two carpellary flowers of Hazel in the axil of a bract (*br*).

Fig. 136.—Diagram of ditto.

carpels, and is syncarpous. The ovules do not develop until after the pollination of the stigma (fig. 137); consequently it is useless to look for ovules before pollination. Each chamber of the ovary (*ov*) then contains one ovule (*o*). At the base of each flower (*i.e.* below the insertion of the ovary) there is a little cup-like envelope (*br.i*)—an involucre. It is well to note that this is not a calyx or a perianth; it is a collection of bracts.*

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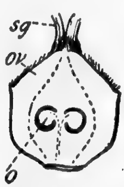

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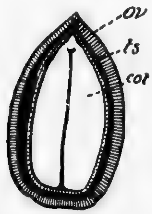


Fig. 137.—Vertical section of recently pollinated gynæcium of Hazel.
Fig. 138.—Vertical section of nut of Hazel.

Fruit. — After pollination the ovules are produced, but, as a rule, only one ovule in an ovary develops fully so as to form a seed. The fruit (fig. 138) is a nut containing the one seed. The involucre originally investing the base of the ovary grows vigorously and forms the green cup (fig. 139, *cp*) round the fruit. **Seed.** — The kernel of the nut is the seed; it has a thin papery testa (*ts*), but possesses no endosperm. The main mass of the seed is

* It is impossible to explain in this book the exact method in which this involucre is formed; but in reality it represents three joined bracts which are also prophylls. The diagram 136 explains the nature of the cupule and the inflorescence in the axil of each bract.

constituted of the two large fleshy cotyledons (*cot*) of the embryo. **Dissemination.**—The fruits merely fall to the ground, or may be carried away by animals (especially squirrels) for future use.

Pollination.—The flowers are wind-pollinated. When the staminate catkins have matured they bend down, and, as their bracts separate, the anthers dehisce and drop pollen on to the bracts below them. The pendulous catkins are easily shaken by the wind, and the pollen may reach the tufts of stigmas.

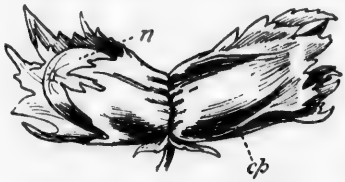


Fig. 139.—Two nuts of Hazel invested with cupules (*cp*).

(i.) Note the inconspicuousness of the flowers which are not visited to any appreciable extent by insects.

(ii.) That a large amount of dry pollen is produced, and easily shaken from the flowers.

(iii.) The large filamentous stigmas.

(iv.) The absence of nectaries.

All these are common features of wind-pollinated flowers.

Table Illustrating the Floral Characters of Other Cupuliferæ.

	Birch (*Betula*).	Oak (*Quercus*).	Beech (*Fagus*).
♂ Inflorescence.	Catkin: 3 flowers in the axil of each bract. Note two prophylls lying within the bract.	Catkin, pendulous: 1 flower in the axil of each bract. No prophylls.	Head-like cluster pendulous.
♂ Flower.	Perianth 2—1-phyllous. Stamens 2, halved, therefore apparently 4 ½-anthers.	Perianth 6-7-lobed. Stamens 6-12.	Perianth 4-7-segmented. Stamens 4-12.
♀ Inflorescence.	Catkin: 3 flowers in the axil of each bract. Note that the bract is fused with two prophylls.	Erect head-like spike: 1 flower in the axil of each bract. Usually no prophylls visible, but a basin-like cupule occurs.	Head-like cluster, 2-flowered, erect.
♀ Flower.	Perianth absent. Ovary 2-chambered, each chamber 1-ovulate: styles 2.	Perianth 3 + 3. Ovary 3-chambered, each chamber 2-ovulate: style 1, stigma 1.	Perianth 3 + 3. Ovary 3-chambered, each chamber 1-ovulate: styles 3.
Fruit.	1-seeded winged achene (samara) No cupule.	Acorn = a nut with a woody cupule. Note that of the six ovules in an ovary, only one develops into a seed.	The 4-valved cupule encloses the infructescence of two fruits. Fruit (from one ovary) is a 3-angled, 1-seeded nut.

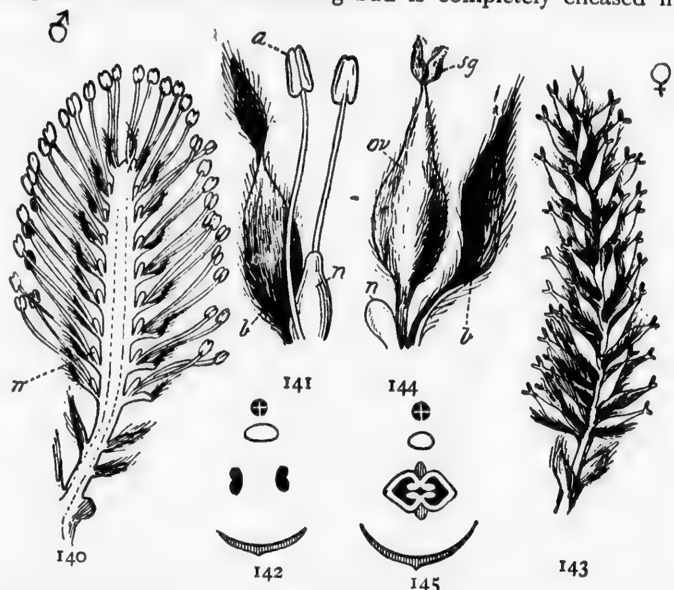
For the remaining characters of these three trees, see the characters of the family.

SALICACEÆ (Willow Family)

Trees or shrubs. Leaves alternate stipulate. Diœcious. The inflorescences are catkins. The staminate flower consists of two or more stamens and a disk. The carpellary flower consists of a hypogynous disk, and a syncarpous superior gynæcium composed of two carpels: ovary, two-chambered, with many ovules on two parietal placentæ: stigmas, two.

TYPE I.: COMMON SALLOW OR WILLOW (*Salix caprea*).

Vegetative characters.—A tree or shrub, with alternate, stipulate leaves. Each resting-bud is completely encased in



Figs. 140-145.—Inflorescence and flowers of *Salix caprea* (Willow). Fig. 140.—Vertical section of staminate inflorescence. Fig. 141.—Staminate flower inserted on a bract. Fig. 142.—Diagram of ditto. Fig. 143.—Carpellary inflorescence. Fig. 144.—A carpellary flower inserted on a bract. Fig. 145.—Diagram of ditto.

two bud-scales. Many of the terminal buds of the branches die in late autumn and drop off during the winter, and in the

following year the highest axillary bud of these branches shoots out, and thus continues the growth of the branch. Thus the Willow-branches are sympodia. **Inflorescences**: the stamens and carpels do not occur on the same individual, the plant is diœcious. The flowers are arranged in catkins which are erect, not pendulous. Each catkin arises, in July, in the axil of a foliage leaf, on a part of the stem formed during that year. The foliage-leaves fall off in autumn. Consequently, when the catkins burst out in the following year (from March to May), they are seen to be in the axils of fallen leaves on a part of the stem which was produced during the previous year. The inflorescences (figs. 140, 143) open before the foliage-leaves emerge from their buds. The axis of the inflorescence bears at its base a few scales, and higher up a number of scale-like bracts and axillary flowers. One flower stands in the axil of each bract. The **staminate** (♂) **flower** (fig. 141) consists of two stamens (*a*) and a greenish nectary (*n*) situated on the base of a bract (*b*). The stamens have long filaments, extrorse anthers, and sticky pollen. The **carpellary** (♀) **flower** (fig. 144) is also inserted on a bract (*b*); it consists of a nectary (*n*) and a syncarpous gynæcium composed of two carpels. The ovary (*ov*) is stalked, and has one chamber which contains many ovules attached to two parietal placentæ. The single short style forks above into a two-armed stigma (*sg*). The nectary is regarded as part of the flower, and, being inserted below the ovary, the flower is described as hypogynous. **Fruit and dissemination.**—The fruit is a two-valved capsule which allows the escape of the numerous minute seeds. The seeds are scattered by the wind, and each seed is possessed of a tuft of silky hairs, which forms the sailing mechanism.

Type II.: POPLARS (*Populus*).

Poplar-trees differ from the Willows in having pendulous catkins, staminate flowers with from four to an indefinite number of stamens [some Willow flowers have as many as five stamens], and dry pollen. Moreover, the flowers have no nectaries, though they possess a hypogynous basin-like outgrowth, which is regarded as either a disk or as a perianth.

Pollination of the Willow and Poplar.—The Willow is insect-pollinated, whereas the Poplar is wind-pollinated. In accord-

ance with these facts we note that the catkins of the Willow are erect, its flowers produce honey, and its pollen is sticky. But the catkins of the Poplar hang loosely and are easily shaken by the wind; the flowers produce no honey; the pollen is dry; and finally the stigma, being lobed to a greater extent than in the Willow, it offers a larger surface for the reception of the pollen.

EUPHORBIACEÆ (Spurge Family)

Plants sometimes having a milky juice. Flowers usually apetalous, diclinous, hypogynous. Perianth small or absent. Gynæcium, syncarpous, with a lobed three- (rarely two-) chambered ovary, having one-two ovules in each chamber. Fruit a capsule. Seeds endospermic.

TYPE: PETTY SPURGE (*Euphorbia peplus*).

Vegetative characters.—An annual herb containing a white milky juice and with simple leaves. **Inflorescence:** the stem, which is simple or has two large branches, terminates in a compound inflorescence, which is an umbel-like cyme of three

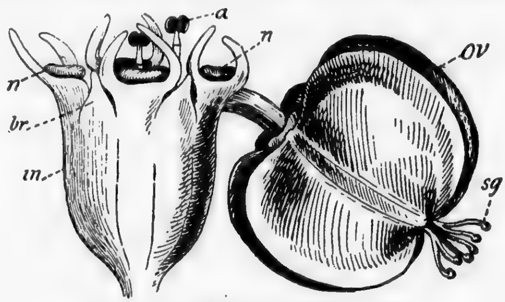


Fig. 146.—Cyathium of *Euphorbia peplus.*

branches. Each of the latter is in turn a two-branched cyme (dichasium), the branches of which may again be forked cymes (dichasia). But throughout the whole inflorescence the actual termination of each shoot is formed by a peculiar inflorescence termed a *Cyathium*, which looks like a simple flower (figs. 146, 147).—The cyathium has a cup-like in-

volucre (*in*) formed by the union of five bracts (*br*) which collectively surround a number of flowers. At the points of junction of four of these bracts are four crescent-shaped *nectaries* (*n*), often described as *glands*. Within the involucre a

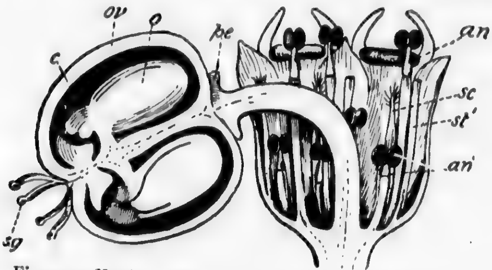


Fig. 147.—Vertical section of cyathium of *Euphorbia peplus*.

number of stamens (*a*, *an*, *an'*) and small scales (*sc*) appear to be ranged round a long-stalked three-lobed ovary (*ov*). **Staminate flower** (fig. 148): each apparent stamen is really a naked staminate flower consisting of only one stamen situated on a flower-stalk. A joint in the stalk of the stamen represents the point at which the filament is inserted on the flower-stalk. The part below the joint is the flower-stalk (*st*), and the portion above is the stamen with a filament (*f*). [In a plant which is closely related to *Euphorbia* there is a little perianth at the joint.] The floral formula is K0 C0 A1 G0. These stamen-like flowers are arranged in five lines opposite the five bracts* (figs. 149, 150). Each of these radial lines of staminate flowers represents an inflorescence standing in the axil of a bract (diagram 149). **Carpellary flower** (figs. 146, 147): the single central gynæcium with its long stalk represents a simple naked flower composed of three carpels. In some spurges there is a distinct hypogynous perianth, consisting of three or six perianth-leaves: even in the Petty Spurge there is a trace of this perianth (*pe*). The ovary (*ov*) is three-lobed and three-chambered, with one

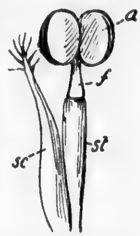


Fig. 148.—A staminate flower of *Euphorbia peplus*, and an adjoining scale (*sc*).

* This is more clearly seen in a large cyathium like that of *Euphorbia lathyris*.

ovule (*o*) in each chamber. There are three forked styles with stigmas (*sg*) on the summit of the ovary. The floral formula is K0 (minute) C0 A0 G $\underline{(3)}$. **Fruit.**—The three-lobed ovary forms a three-valved capsule. **Seed.**—Endospermic.

We see therefore that the cyathium (figs. 149, 150) is a cymose inflorescence consisting of one terminal carpellary

Fig. 149.—Diagram of cyathium of *Euphorbia*. 1, 2, 3, 4, 5 are bracts.

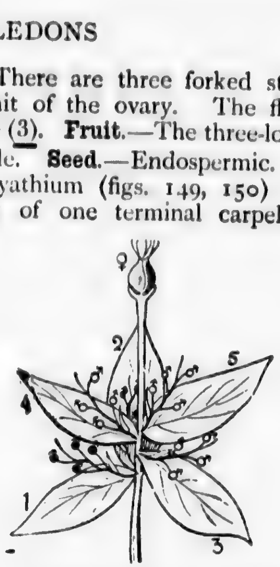


Fig. 150.—Scheme of cyathium of *Euphorbia*. 1, 2, 3, 4, 5 are bracts.

flower and lateral staminate inflorescences arising in the axils of five bracts which form the involucre.

RANUNCULACEÆ (Buttercup Family)

Usually herbs. Leaves alternate (except *Clematis*). Flowers, usually showy, acyclic or hemicyclic, regular (except Monkshood and Larkspur), hypogynous. Sepals polysepalous, often petaloid. Petals polypetalous or absent. Stamens numerous. Carpels usually more than one, apocarpous, superior. Seed endospermic.

TYPE I.: BUTTERCUPS (*Ranunculus acris*, *R. bulbosus*, *R. repens*).

Vegetative characters.—Perennial herbs. Leaves alternate, simple, deeply divided. Stipules are absent, but there is a leaf-sheath at the foot of the petiole. In the first two species

the stem is erect, and in *R. bulbosus* it is swollen at the base. In *R. repens* the stem is not erect, but forms creeping runners, which are fixed to the soil by adventitious roots given off from the nodes. **Inflorescence**:—cymose; the axis ends in a flower. When present, the lateral inflorescences are two-branched (dichasia) or one-branched (monochasia). Note the two small prophylls on each lateral axis of the inflorescence, and that in the region of the flowers the leaves are simplified; they are bracts. **Flower** (figs. 60, 61).—The flowers of these three species of buttercup are so alike that one general description will suffice. The flowers are hemicyclic, monoclinous (☿), regular, and hypogynous. *Sepals* (*cal*, *sp*) five, separate, green. *Petals* (*cor*, *p*) five, alternating with the sepals, separate. Note that there is a little pocket—the *nectary* (*n*)—at the base of the inner face of each petal. *Stamens* (*and*) numerous (∞), hypogynous, spirally arranged, separate. *Carpels* (*gyn*) numerous (∞), apocarpous, superior, spirally arranged on a conical *receptacle* (*r*). Each carpel contains one basal ovule (*o*) in its one-chambered ovary; style, very short; stigma, knob-like. **Fruit**:—compound, consisting of numerous achenes (fig. 115) upon a common receptacle. (Each achene is derived from one carpel.) **Seed** endospermic (*end*) with a minute embryo (*emb*). **Pollination**.—The outermost stamens ripen before the inner ones and before the carpels. Their anthers dehisce towards the petals. At this early stage the flower is practically staminate, for the stigmas cannot be pollinated because they are not ripe, but are covered by the closed anthers of the inner stamens. Gradually the rest of the stamens ripen and dehisce, but the stigmas are ready for pollination before the innermost stamens have dehisced. Thus, when it first opens, the flower cannot be pollinated, subsequently it can be either cross-pollinated or self-pollinated. Many kinds of insects (beetles, flies, bees, and butterflies) visit the flowers for the sake of the scarcely-concealed honey or for the pollen, and act as pollinating agents.

TYPE II.: MONKSHOOD (*Aconitum napellus*).

The Monkshood differs from the Buttercups in the following points:—*Inflorescence*, a terminal raceme. *Calyx* (*ps*, *as*, *ls*) blue, petaloid; of the five sepals the posterior

one (*ps*) is hood-like; irregular. *Petals* eight; the two posterior (*pp*) petals are long-clawed nectaries concealed under the large posterior sepal; the other petals (*ap*) are small or absent. There are three separate *carpels*, each with many parietal ovules in the ovary. The *fruit* consists of three follicles. The flower is irregular, and is zygomorphic in a median plane. **Pollination.**—The flower is proterandrous;

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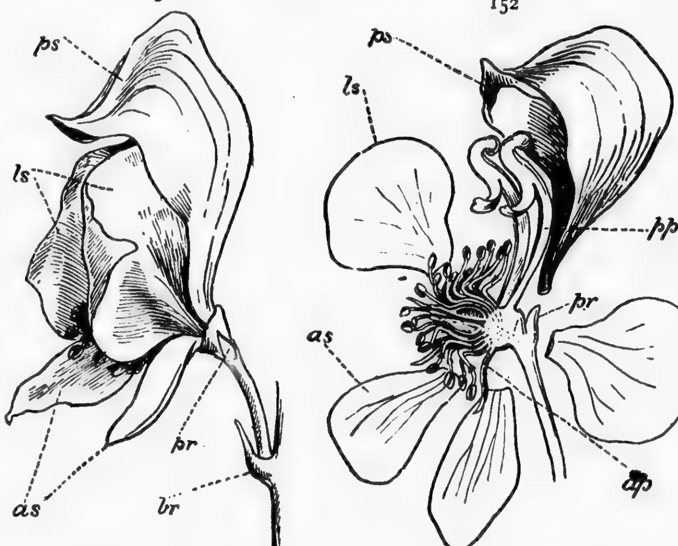

Figs. 151, 152.—Flower of Monkshood: *br*=bract; *pr*=prophylls.

pollination by its own pollen appears to be thus rendered impossible. Cross-pollination is accomplished exclusively by the aid of humble-bees. As the humble-bee alights on the flower, it uses the two lateral sepals as a platform, and the consequence is that the lower surface of the bee's body comes into contact with the anthers and stigmas. In freshly-opened flowers it is the anthers against which the insect strikes. But in older flowers the stamens have bent back, and the stigmas, which are now ripe, touch the lower surface of the body of the bee at precisely the same spot as do the anthers in a younger

flower. This arrangement favours cross-pollination. The insect, when visiting the inflorescence, commences at the lowest flowers, and travels up the inflorescence. In this manner pollination by the pollen even of the same plant is averted. The long-stalked nectaries are completely concealed from outside view, nor can their honey be reached excepting with great difficulty by any insects other than humble-bees. The Monkshood-flower is a flower especially adapted for pollination by the agency of these particular insects, consequently it is absent from those regions of the earth which are without humble-bees.

Comparison between the pollination and flowers of the Buttercup and of the Monkshood.—The yellow Buttercup-flower is actinomorphic, and is directed upwards. Inasmuch as its nectaries are feebly concealed and easily accessible, insects with quite short tongues can discover and reach the honey. The flower is therefore visited by many (more than sixty) kinds of insects. These alight on the petals or on the carpels, and may cause cross-pollination or self-pollination. The blue Monkshood-flower is zygomorphic, and is inclined to the horizon. Its honey is carefully concealed and protected, so that only specialised insects can discover and reach it. The flower is pollinated exclusively by one group of insects—humble-bees—which visit in one particular way, and necessarily effect cross-pollination as they go from plant to plant. Self-pollination is impossible in the Monkshood-flower. The Monkshood- and Buttercup-flowers thus illustrate the fact that the colours and shapes of flowers are associated with the varieties of insects which visit and pollinate those flowers. We also see that the irregular zygomorphy is a means employed to cause the visiting insect to deal with the flower in a particular manner so as to ensure cross-pollination. Finally, we note that the zygomorphic flowers are associated with certain classes of insects, not, as is the Buttercup, with many varieties of flower-visiting insects.

[TABLE

TABLE SHOWING THE CHARACTERS OF OTHER RANUNCULACEÆ.

NAME.	SYMMETRY.	SEPALS.	PETALS.	FRUIT, a collection of	NOTES.
Clematis.	⊕	Petaloid.	Absent.	Achenes.	Climbing by means of the stalks of the opposite leaves. Achene blown by the wind, and possessing a persistent feathery style.
Anemone.	⊕	Petaloid.	Absent.	Achenes.	Involucre.
Marsh Marigold (*Caltha palustris*).	⊕	Yellow, petaloid.	Absent.	Follicles.	Honey excreted by the bases of the carpels.
Christmas Rose (*Helleborus*).	⊕	Large, persistent, sometimes petaloid.	About 13, spirally arranged, tubular nectaries.	Follicles.	Transition from foliage-leaves to bracts and sepals.
Winter Aconite (*Eranthis hiemalis*).	⊕	6, petaloid.	6, tubular nectaries.	Follicles.	Involucre.
Larkspur (*Delphinium ajacis*).	↓	5, blue, petaloid; irregular; posterior is spurred.	1, posterior blue spur, which possibly may represent two joined petals.	1, follicle.	

PAPAVERACEÆ (Poppy Family)

Herbs with milky juice. Leaves exstipulate. Flowers usually showy, regular, hypogynous. Sepals, two (three), polysepalous. Petals, 2 + 2, polypetalous. Stamens numerous. Carpels, from 2 to ∞, syncarpous: ovary one-chambered, with many ovules on parietal placentæ. Fruit dehiscent. Seeds endospermic.

TYPE I: FIELD-POPPY (*Papaver rhœas*).*

Vegetative characters.—Annual herbaceous plant, with milky juice (latex) and bristly hairs. Leaves alternate, stalked,

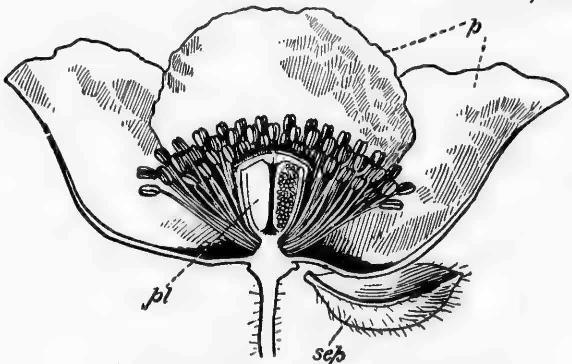

Fig. 153.—Vertical section of flower of Poppy.

without stipules, simple, pinnately cleft. **Flower** (fig. 153) solitary, terminal, actinomorphic, hypogynous. *Sepals* (*sep*) two, separate, falling off as the flower opens. *Petals* (*p*), 2 + 2, separate, arranged in two alternating whorls of two each; the outer two also alternate with the two sepals. The petals are crumpled in the bud; each petal may have a black spot at the base of its inner face. *Stamens* numerous (∞), hypogynous. *Carpels* from eight to twelve, syncarpous, superior. Ovary (*ov*) one-chambered, with from eight to twelve parietal placentæ (*pl*) protruding inwards from the wall, and having many ovules on their faces (also fig. 155). Stigmas (fig. 154 *s*) from eight to twelve, sessile, forming velvety bands radiating

* The flowers of almost any sort of Poppy may be examined in place of the one here described.

from the centre of the roof of the ovary. We should expect the stigmas to lie above the gaps between the placentæ, because a stigma usually stands above the dorsal suture (mid-rib) of the carpel to which it belongs. But in the

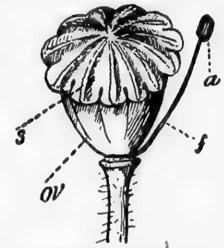

Fig. 154.—Gynæcium and one stamen of Poppy.

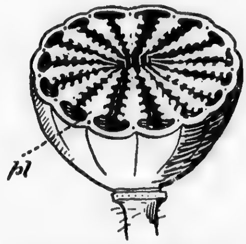

Fig. 155.—Cross-section of ovary of Poppy.

Poppy the stigmas stand directly above the placentæ, instead of alternating with them. When stigmas are thus superposed on the placentæ they are said to be *commissural.* **Fruit** (fig. 126) a capsule, opening by lateral pores which alternate with the stigmas. **Seeds** minute, and easily transported by the wind. **Pollination**: the flower has no nectaries, but is visited by insects desiring its pollen.

Type II.: COMMON CELANDINE (*Chelidonium majus*).

Herb with yellow juice and yellow flowers. Its flowers differ from those of the Poppy in that the gynæcium consists of two combined carpels, with two commissural stigmas surmounting a one-chambered ovary possessed of two parietal placentæ. The fruit (fig. 121) is a *siliqua*, which has no septum; consequently the persistent placenta (*r*) (*replum*) forms an empty frame which bears the ovules.

Uses, Peculiarities, etc. of Papaveraceæ.—The latex of *Papaver somniferum* is the source of opium. *Eschscholtzia* is a familiar garden plant, with flowers tending to become perigynous.

CRUCIFERÆ (Wallflower Family)

Herbs. Leaves alternate, exstipulate. Inflorescence, racemose, usually without bracts. Flower, regular, hypogynous.

Sepals, 2 + 2, polysepalous. Petals, 4, polypetalous. Stamens, 2 + 4, two short and four long. Carpels, 2, syncarpous: ovary, divided by a false septum connecting two parietal placentæ; ovules numerous. Fruit usually a siliqua. Seed, no endosperm.

TYPE I.: WALLFLOWER (*Cheiranthus cheiri*).*

Vegetative characters.—A perennial herb, slightly woody at the base. Leaves alternate, exstipulate, simple. **Inflorescence**: a raceme without bracts. Note the absence of prophylls from the flower-stalks. **Flower** (fig. 156) actino-

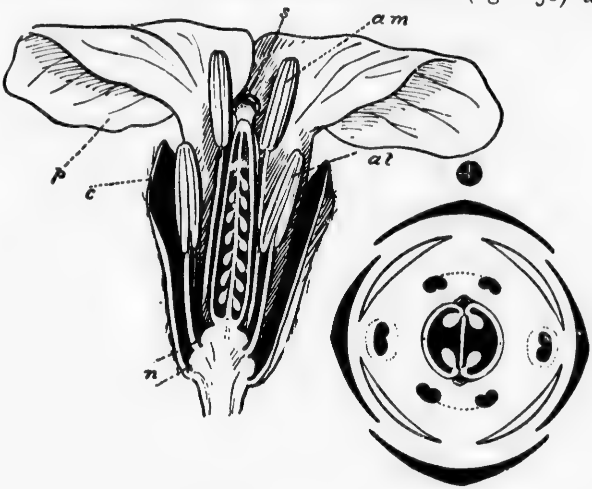

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Fig. 156.—Vertical section of flower of Wallflower.
Fig. 157.—Floral diagram of ditto.

morphic, hypogynous, brown or yellow, sweet-scented. *Sepals* 2 + 2, separate. The four sepals are arranged in two alternating whorls of two each. The two lateral sepals (*c*) form the inner whorl, and are inserted higher on the receptacle than the two outer median sepals. The lateral sepals are slightly enlarged

* Almost any Crucifer will serve in place of the Wallflower, so uniform is the structure of the flowers, excepting as regards the nectaries.

and pouched at their bases: the little pouches act as receptacles to hold the honey poured out by the nectaries. *Petals* (*p*) four, separate, arranged in one whorl alternating with the four sepals. Note the blade (*la*) and claw (*cl*) of each petal (fig. 83). *Stamens* (figs. 156, 88) 2+4, hypogynous, separate. There are two short stamens (*at*) and four long ones (*am*). The two shorter stamens are opposite the inner (lateral) sepals, and are inserted at a lower level than the four long stamens. Therefore the two shorter stamens form an outer whorl, and the four long ones constitute an inner whorl of stamens. *Nectaries* (figs. 156, 88): a green nectary (*n*) is situated at the base of each of the two shorter stamens. *Carpels* (figs. 156, 88) two syncarpous, superior. Ovary (*ov*): the two parietal placentæ, bearing numerous ovules, are connected by a delicate partition (septum) which divides the cavity of the ovary into two chambers. When an ovary is divided into several chambers, and contains numerous ovules, the placentation is usually axile; but in the Cruciferæ the ovules are attached to the walls, and not to the axial partition. It is for this reason that the partition is regarded as not originally a true part of the carpels, and is therefore termed a *false septum* (fig. 156). The short style is surmounted by two commissural stigma-lobes (*s*). **Fruit** (fig. 120) a pod-like siliqua. It is necessary to distinguish between the persistent placentæ forming the replum (*re*) and the false septum (*fs*). **Seed** (fig. 116) contains no endosperm, the embryo is bent. The seeds are compressed, and are easily carried about by the wind, and are thus able to reach the tops of walls, on which the plants frequently grow.

Type II.: SHEPHERD'S PURSE (*Capsella bursa pastoris*).

This plant is an annual little weed, in reality an ephemeral, flowering at nearly all seasons of the year. The inflorescence and flowers are constructed on the same plan as those of the Wallflower. The length of the four long stamens is such as to occasion regular self-pollination. The fruit is of peculiar shape, and is a shortened siliqua.

Uses, peculiarities, etc., of Cruciferæ.—Though they appear so different, Cabbages, Cauliflowers and Broccolis, Brussels-sprouts, Turnips, Rape, and Mustard are plants all belonging to the same genus—*Brassica*. They are placed in one single

genus, because the flowers, fruits, and seeds are closely alike. The Cabbage (*Brassica oleracea*) is cultivated for the sake of its large leaves. The Brussels-sprouts is merely a variety of cabbage producing many large green axillary buds which form the edible portions. The Cauliflower and Broccoli are other varieties of the cabbage, cultivated for the sake of their much-branched inflorescences, the stems of which are fleshy and colourless, the flowers being reduced to minute buds. The "heart" of a Cauliflower or Broccoli is a branched terminal inflorescence. The Turnip (*Brassica campestris*) is a biennial possessing a tuberous main root, which we eat as a vegetable. The Swede is a variety of the Turnip, also cultivated for the sake of its swollen tap-root. The Rape is still another variety of *B. campestris*, and from its seeds colza-oil is obtained. The seeds of the Black Mustard (*Brassica nigra*) are the source of the condiment mustard. We use the young plants of the White Mustard (*Brassica alba*) in the composition of salads; this is the Mustard cultivated with Cress to form "mustard and cress." Cress (*Lepidium sativum*) is also one of the Cruciferæ. The edible part of the Horse-Radish (*Cochlearia armoracia*) is the rhizome (not the root): the leaves of the Horse-radish are stipulate. The swollen red tubers of the Radish (*Raphanus sativus*) are formed mainly by the hypocotyl. Water-cress (*Nasturtium officinale*) also belongs to this family. A few Cruciferæ are cultivated in gardens for the sake of their flowers: such are the Stocks, Candytuft (with zygomorphic flowers).

VIOLACEÆ (Violet Family)

Herbs. Leaves alternate, stipulate. Flowers often showy, irregular, hypogynous. Sepals five, polysepalous. Petals five, polypetalous. Stamens five. Carpels three, syncarpous; ovary one-chambered, with three parietal placentæ bearing many ovules. Fruit, a three-valved capsule.

Type: PANSY (*Viola tricolor*).

Vegetative characters.—Herb. Stem branched, with or without a rhizome. Leaves alternate, stalked; stipules large, leaf-like. Leaves rolled towards their upper faces in the bud.
Inflorescence.—The flower is solitary, axillary. Note the two prophylls (fig. 158-3, *pr*) inserted at a considerable distance up

the flower-stalk. **Flower** median-zygomorphic, hypogynous. *Sepals* five, separate. Note the prolongation of the sepals below their points of attachment. *Petals* five, separate, irregular. The anterior petal is produced into a long spur

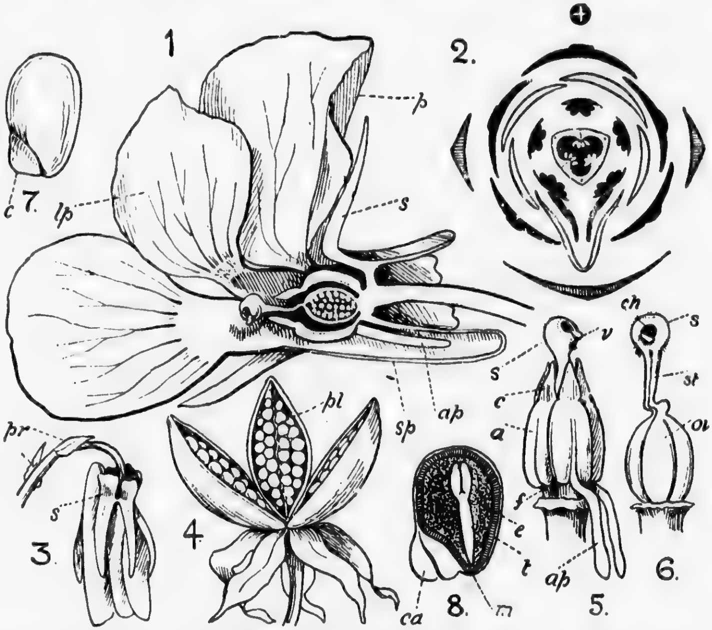

Fig. 158.—Pansy. 1. Vertical section of flower: *s*=sepal; *lp*=lateral petal; *sp*=spur of anterior petal; *ap*=appendage of one of two anterior stamens. 2. Floral diagram. 3. Flower-bud, showing æstivation: *s*=descending process of sepal. 4. Fruit: *pl*=placenta. 5. Flower with calyx and corolla removed: *ap*=appendages of two anterior stamens; *f*=filament; *a*=anther; *c*=continuation of connective; *s*=swollen end of style; *v*=shutter of stigma-cup. 6. Gynæcium: *ov*=ovary. 7. Seed with lump (*c*). 8. Vertical section of seed: *ca*=lump: *m*=micropyle; *t*=testa; *e*=endosperm. (1-6 based on Kny's figures of Pansy.)

(fig. 158-1, *sp*) which conceals the two nectaries and acts as a honey receptacle. The petals are arranged in the bud condition in the manner known as *descending*-imbricate. *Stamens* (fig. 158-5) five, hypogynous. Anthers (*a*) introrse, arranged close together round the single gynæcium. The connectives are continued above the anthers, and form little flaps (*c*). The

filaments (*f*) are very short. The filament of each of the two anterior stamens sends a slender elongated process or appendage (*ap*) into the spur of the anterior petal. The green spots at the ends of these two appendages secrete honey, and are the *nectaries*. *Carpels* (fig. 158-6) three, superior, combined. Ovary (*ov*) one-chambered, with three parietal placentæ which bear many ovules. Style (*st*) one, club-like, with a stigma in a pit (*ch*) on the anterior surface of its summit (*s*). **Fruit** (fig. 158-4) a capsule splitting down the dorsal sutures. The three valves contract and jerk out the smooth seeds. **Seed** (figs. 158-7-8) endospermic, with a lump (*c*, *ca*) near the micropyle. **Pollination.**—The anthers dehisce towards the gynæcium at the same time as the stigma ripens. At first sight it appears that self-pollination is inevitable; and, indeed, self-pollination does take place in the whitish-yellow small-flowered variety of the Pansy (*V. tricolor* var. *arvensis*). But in the large-flowered variety of Pansy, which possesses variegated flowers, self-pollination is hindered by a very neat mechanism. The stigma-cup has a little shutter or flap (fig. 158-5, *v*) hinged on to its lower edge. A bee visiting the flower alights on the anterior petal, and, in order to sip the honey, it must push its tongue into the spur of the petal. In so doing, the tongue necessarily passes along the hairy groove between the stigma and the anterior petal. The pollen collects in this groove. Consequently, when the bee alights, its tongue first rubs against the stigma and drags open the "shutter," so that any pollen previously present on the bee's tongue is rubbed into the stigma-cup. As the tongue is pushed farther towards the honey it comes now for the first time into contact with the pollen belonging to the flower itself; and in this way the tongue becomes coated with the flower's own pollen. When the bee has obtained some honey and proceeds to withdraw its tongue, the backward movement of the latter closes the shutter of the stigma-cup, and thus prevents the pollen of that flower from being rubbed into the stigma-cup. In the large blue or variegated flowers of the large-flowered variety of Pansy, the honey is so deeply placed (because the spur is long) that it can be reached only by insects with long tongues: these flowers are pollinated chiefly by bees and humble-bees. On the other hand, in the small yellow or yellowish-white flowers of the other variety of Pansy the honey is more easily accessible: consequently these flowers are visited

by insects with shorter tongues (beetles and flies) as well as by bees. It is well to note that the yellow-flowered form has more accessible honey and a wider circle of visitors than the blue-flowered form, which is a "bee-flower"; and to compare this with the case of the yellow Buttercup and the blue Monkshood. Some of the flowers of the small-flowered variety do not open, but pollinate themselves.

The Violets belong to the same genus (*Viola*) as the Pansy, and have their flowers constructed on the same general plan; but the structure of the stigma varies in different species. Many violets have two different kinds of flowers. In the springtime they produce the familiar white or blue flowers; but later in the year they bear a second crop of flowers which are minute and bud-like, and incapable of opening. These closed flowers pollinate themselves and are hence said to be *cleistogamic*.

CARYOPHYLLACEÆ (Pink Family)

Herbs. Leaves opposite. Inflorescence cymose. Flowers regular, cyclic, hypogynous. Sepals four or five. Petals four, five (or none), polypetalous. Stamens usually eight or ten, often obdiplostemonous, usually hypogynous. Carpels from two to five, syncarpous, superior; ovary one-chambered: ovules many, on a central placenta; styles from two to five. Seed perispermic, embryo curved.

Type I.: CHICKWEED (*Stellaria media*).

Vegetative Characters.—Annual herb, much branched in a cymose manner (fig. 43). Note the line of hairs on one side of each internode, continuous with a fringe of hairs on the bases of the leaves. Leaves opposite, exstipulate, simple, entire; lower leaves stalked, upper leaves sessile. **Inflorescence** axillary, commences as a two-branched cyme (dichasium). **Flower** (fig. 159) ☿ regular, cyclic; small, white. The flowers vary considerably, but a complete typical flower will be described first, and then the variations will be noted. *Sepals* (*cx*) five, separate. *Petals* (*co*) five, separate. Note the deep division of each petal. *Stamens* 5 + 5, hypogynous. The stamens composing the outer whorl (*ap*) are opposite to the petals: whilst the five inner stamens (*as*) alternate with them. The flower is therefore obdiplostemonous. Anthers

introrse. *Nectaries* (*n*) five, very small knobs standing outside the five inner stamens and, therefore, opposite the sepals.

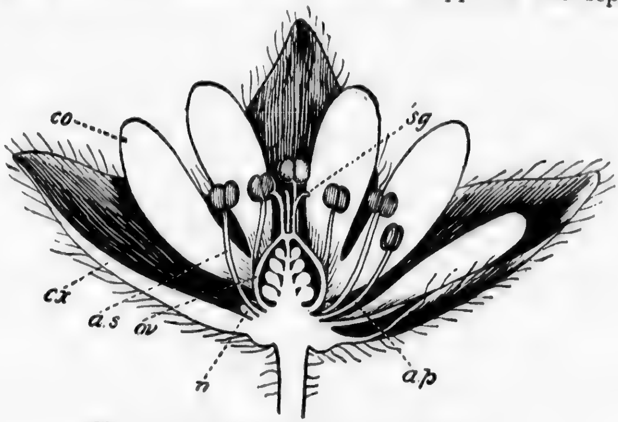

Fig. 159.—Vertical section of flower of *Stellaria media.*

Carpels three, syncarpous, superior: styles three: ovary (*ov*) one-chambered, with many ovules on a central placenta. **Fruit** (fig. 124) a capsule, opening by six valves. **Seed** (fig. 117) small, kidney-shaped, with perisperm. **Variations in the flower.**—The sepals and carpels remain constant in number (excepting that very rarely the sepals may be six in number). In some flowers the five stamens which should be opposite the petals are wanting: in others there are only three stamens, which are opposite three sepals: in still other flowers no stamens are present, so that the flower is carpellary. Again, in some cases the petals are wanting. **Pollination.**—The plants are found in flower throughout the year. The honey is accessible to short-tongued insects, and the flowers are cross - pollinated

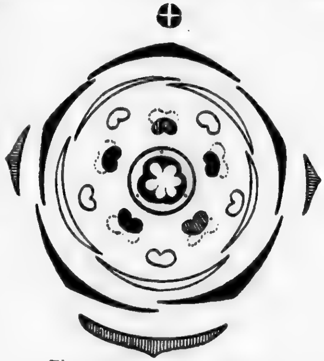

Fig. 160.—Floral diagram of *Stellaria media.*

by the agency of many kinds of insects (bees, beetles, flies, etc.). Self-pollination often takes place in open flowers, because the stigmas come in contact with the anthers; but it also occurs in flowers which remain closed. These closed self-pollinating flowers are merely ordinary flowers which fail to open; they are not reduced and altered as are the cleistogamic flowers of the Violet.

OTHER TYPES: PINK (*Dianthus*): CATCHFLY (*Silene*): CAMPION (*Lychnis*).

The flowers of these plants differ from those of the Chickweed more particularly in having a tubular gamosepalous calyx and long-clawed petals. Their honey is consequently concealed at the bottom of a long tube, and cannot be reached by short-tongued insects. These flowers are exclusively pollinated by insects with long tongues—*i.e.* mainly by butterflies and moths. The comparison between these flowers and those of *Stellaria* gives us additional evidence for the view that the shapes of insect-pollinated flowers bear relation to the sorts of insects which pollinate them (see pages 81, 82 and 119-121). It is important to note that Pinks are pollinated by butterflies flying during the daytime, and that they often have a pink colour and delicious scent. Contrast this with the white colour of the flowers of *Lychnis vespertina*, which open at dusk, give out their strongest scent at that time, and are pollinated by night-flying moths. The white colour renders flowers more conspicuous at night.

MALVACEÆ (Mallow Family)

Herbs or shrubs. Leaves alternate, stipulate. Flowers regular, hypogynous, often showy. Sepals five, gamosepalous, valvate. Petals five, nearly polypetalous, joined to the stamens at the base. Stamens numerous, filaments united. Anthers with only two pollen-sacs each. Carpels from three to ∞, syncarpous (or apocarpous). Ovary with from three to many chambers.

TYPE: MALLOWS (*Malva sylvestris* and *M. rotundifolia*).

These two species may be treated together, as they are very similar.

Vegetative characters.—Herbs with hairs. Leaves alternate, stipulate, simple, palmately-veined, lobed, margins scalloped. The leaves are folded in the bud. **Inflorescence,** axillary tufts

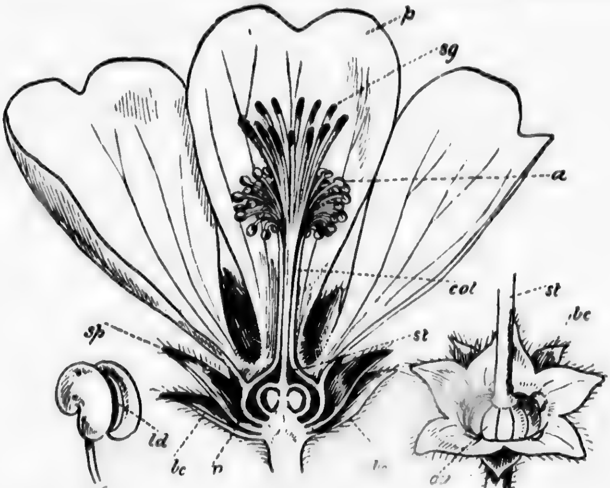

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Fig. 161.—Vertical section of flower of *Malva sylvestris.*
Fig. 162.—Upper part of stamen of ditto, showing dehiscence of anther.
Fig. 163.—Portion of flower of ditto, showing calyx, epicalyx (*bc*), and part of style: the stamens and petals are removed.

too complicated for description here. Three bracts close beneath the calyx form an involucre, which is known as the epicalyx (*bc*). **Flower** (fig. 161) actinomorphic ☿, cyclic, showy. *Sepals* (*sp*) five, combined, valvate in the bud. *Nectaries* five pits on the bases of the five sepals, protected by hairs on the margins of the bases of the petals. *Petals* five, contorted in the bud. The petals are united to one another and to the stamens by their bases. *Stamens* numerous, united by their filaments to form a tube (*col*), epipetalous. The numerous stamens are in reality produced by a branching of five stamens placed opposite the five petals. Each anther has only two pollen-sacs, and represents only half a complete anther; it is kidney-shaped (fig. 162). *Carpels* (figs. 161, 163) several, syncarpous, superior. Ovary (*ov*)

with several chambers, each representing one carpel and containing one ovule attached to the axile placenta. Style (*st*) one, which divides above into as many branches as there are carpels and ovary-chambers: each branch of the style is stigmatic on its inner and upper surface. **Fruit** (fig. 164) a schizocarp splitting into one-seeded cocci (*cc*). **Pollination.** — In both these species of Mallows the stamens ripen before the carpels, and their opened anthers form a group round the closed erect style-branches. As the stigmas ripen and commence to separate, the filaments gradually bend backwards and outwards. In *M. sylvestris* the anthers are carried completely out of reach of the stigmas, so that the flower cannot pollinate itself. But in *M. rotundifolia* the anthers are not borne so far backwards, whilst the style-branches gradually curl over and bring the stigmas into contact with the open anthers: thus the flower can regularly pollinate itself. The flowers of *M. sylvestris* are more showy, and are visited more frequently by insects which cause cross-pollination. Thus we see that of these two flowers which are so much alike, the more conspicuous is more frequently visited by insects, and consequently more extensively cross-pollinated. This tends to prove that conspicuousness of flowers aids in attracting insects. On the other hand, the less conspicuous flower of *M. rotundifolia* is more often self-pollinated. This fact goes to show that the more perfectly cross-pollination by insects is ensured, the more precautions are taken to avert self-pollination; and that, on the other hand, when cross-pollination is not adequately secured, the flower makes provision for the formation of seeds by self-pollination. Putting both results together, we see that flowers are conspicuous in order to attract insects which shall effect cross-pollination.

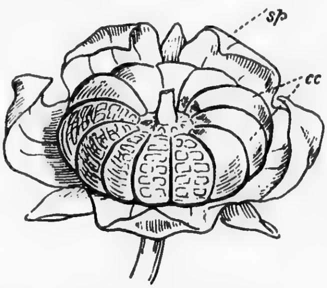

Fig. 164.—Fruit of *Malva sylvestris*: *sp*=sepals; *cc*=cocci.

GERANIACEÆ (Geranium Family)

Herbs with stipulate leaves. Flowers usually regular, hypogynous. Sepals five. Petals five, polypetalous. Stamens 5 + 5, obdiplostemonous, or only five; filaments slightly united at their bases. Carpels five, syncarpous; ovary, five-chambered. Fruit possessing a "beak."

TYPE: HERB ROBERT (*Geranium robertianum*).

Vegetative characters.—Herb, strongly scented, erect or spreading. Leaves alternate, stipulate, simple, deeply divided. The leaf is in the first place incompletely divided into three

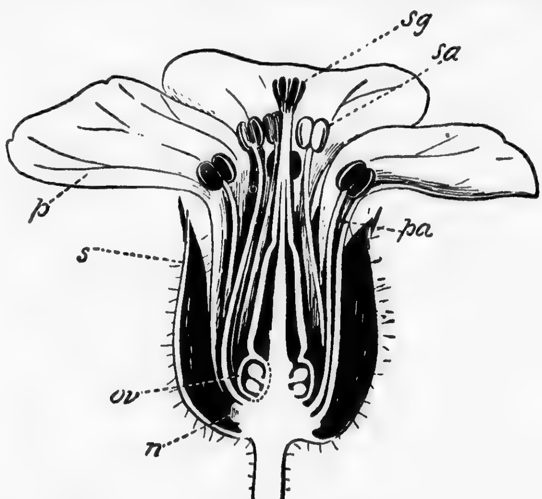

Fig. 165.—Vertical section of flower of Herb Robert.

primary divisions, thus showing that the venation is essentially palmate, though the finer nerves are pinnate. **Branching and Inflorescence.**—The branching at the summit of the stem is cymose: the primary method of branching is forked (dichasium), but the subsequent branches are monochasia. The flowers are ultimately arranged in pairs. Each pair represents a monochasium with a terminal flower and a lateral flower which arises in the axil of the larger of the two prophylls of that axis. **Flower** (fig. 165) actinomorphic, ☿, cyclic: purplish-red.

Sepals (*s*) five, imbricate. *Petals* (*p*) five, separate. *Stamens* 5 + 5, with their filaments slightly combined at their bases. The stamens (*pa*) forming the outer whorl are opposite the petals (obdiplostemonous) and are shorter than those (*sa*) opposite the sepals; anthers, introrse. *Nectaries* (*n*) five lumps opposite the sepals, and lying between them and the five inner stamens. *Carpels* five, syncarpous, superior. Ovary (*ov*) five-lobed, five-chambered: each chamber contains two ovules attached to the axile placenta. Style single, but dividing above into five branches with stigmas (*sg*). It is important to note that the ovary-chambers and five style-branches are opposite to the petals. Thus the five carpels are opposite to the petals instead of being opposite to the sepals: this is an additional peculiarity of many obdiplostemonous flowers.

Fig. 166.—Floral diagram of Herb Robert.

Fruit (fig. 167).—The main single part of the style elongates, and becomes a strong "beak." Only one ovule in each chamber forms a seed. When the fruit is ripe, as it dries, the five carpels separate, one by one or simultaneously, from below upwards in such a manner that the five seed-containing chambers (cocci) are carried up by elastically curling strips of the "beak," and are thrown off. The fruit is a peculiar schizocarp, because the carpels do not open whilst still attached to the mother-plant. In some of the British species of *Geranium* the

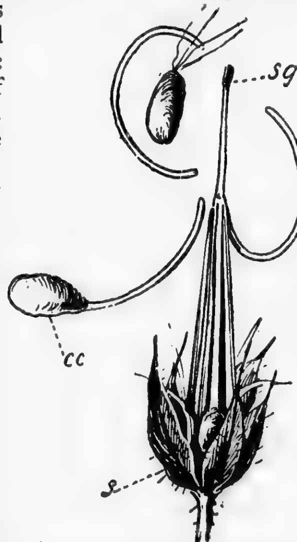

Fig. 167.—Fruit of Herb Robert.

carpels open, and the seeds are violently thrown out as the strips of the beak contract, so that their fruits are explosive capsules.

OXALIDACEÆ (Woodsorrel Family)

This family is often included in the Geraniaceæ. The typical floral formula is the same in both families K5 C5 A5 + 5 $G(\underline{5})$. The Oxalidaceæ differ from *Geranium* in the following respects:—(i.) The leaves are compound. (ii.) Often there are more than two ovules in each of the five chambers of the ovary. (iii.) There are five styles. (iv.) The capsular fruit has no "beak."

TYPE: WOODSORREL (*Oxalis acetosella*).

Herb with a rhizome, which is a true axis and not a sympode. The leaves are compound, digitate, with three leaflets. Note their day- and night- movements (figs. 249, 250). Inflorescence is cymose. Flowers ⊕ white. (i.) The petals are contorted in the bud. (ii.) The five nectaries are opposite the petals, and lie between them and the five outer stamens. (iii.) The plant produces small cleistogamic flowers in addition to ordinary white ones. (iv.) The fruit is a capsule dehiscing along the dorsal sutures: the seeds are ejected violently from it by the elastic contraction of a white fleshy coat which envelops each seed separately like an outer testa.

PAPILIONACEÆ (Pea Family).

Herbs or shrubs. Leaves alternate, stipulate, usually compound. Flowers irregular, cyclic, weakly perigynous. Sepals five, gamosepalous. Petals five, polypetalous, consisting of a standard, two wings, and a keel. Stamens ten, weakly perigynous; filaments of all, or of all but one, combined. Carpel one, superior. Fruit usually a legume. Seed non-endospermic.

TYPES: GARDEN PEA (*Pisum sativum*): WHITE CLOVER (*Trifolium repens*).

Vegetative characters.—Herbs, with alternate compound stipulate leaves. The Clover is a creeping perennial, its leaves (figs. 251, 252) having three leaflets and two small stipules

each. The pea is a climbing annual with pinnate leaves (fig. 59) and large green persistent stipules (*n*); some of the leaflets are converted into tendrils (*br*). **Inflorescences** axillary: capitulum in the clover; peculiar, two-flowered in the pea. **Flowers** (figs. 96, 97) median-zygomorphic, irregular, ☿, cyclic, perigynous. *Sepals* five, combined to form a five-toothed cup. *Petals* five, polypetalous, irregular. The posterior petal (*sd*) is the largest, and is termed the standard (*vexillum*); the two lateral petals (*w*) are termed the wings (*alæ*); whilst the two anterior petals (*k*), which have separate claws, cohere by their blades, and form the boat-shaped keel (*carina*). The æstivation (fig. 101) is *descending-imbricate* (see page 73). *Stamens* (fig. 87) ten, weakly perigynous. The single posterior stamen (*pa*) is separate, but the filaments of the nine others cohere to form a tube (*an. t*), which is open only along its posterior face (as well as at the summit). Though the ten stamens represent two whorls of five each, all ten are inserted at the same level on the receptacle. The stamens lie hidden inside the keel, and they in turn conceal the single ovary. The base of the inner face of the staminal tube acts as a *nectary*. *Carpel* one, superior; ovary (*ov*) one-chambered, bearing a double line of ovules on the parietal placenta; style one; stigma (*sg*) simple. **Fruit** (fig. 119), a legume. *Seeds* non-endospermic. **Pollination.**—Like the flowers of all the Papilionaceæ, these flowers are specially constructed for pollination by means of bees. The bee alights on the flower in such a way as to use the alæ as a platform. This depresses the alæ, which in turn drag the keel (carina) down. In this manner the upwardly directed stigma and the pollen inevitably come into contact with the under-surface of the bee's body. The bee thrusts its tongue into the slit on the upper (posterior) face of the staminal tube and sips the honey which accumulates between the base of the ovary and the base of the staminal tube. When the bee flies away, the two alæ and the keel rise up again and assume their former positions. The bee, visiting flower after flower, may thus effect cross-pollination. The flowers may self-pollinate themselves. In these flowers we may note: (i.) How completely the alæ and carina protect the honey and pollen from rain and marauding insects. (ii.) The honey can only be reached from above (from the posterior face of the staminal column). (iii.) The alæ, when forced down,

drag the carina with them, because they are inter-locked with (*e.g.* Pea), or actually joined to (*e.g.* Clover), the sides of the carina. [Try and see what causes the wings and keel to return to their places when the pressure of the bee is removed.]

OTHER TYPES OF PAPILIONACEÆ.

In the flower of the Broom and some other Papilionaceæ the filaments of all ten stamens are joined together, but there still remains a small window-like opening on each side of the base of the posterior stamen. These two openings render the honey accessible to bees. The White Clover has a creeping stem; the Broad Bean (*Vicia faba*) is an erect plant; the Pea, Vetches, and others climb by tendrils, which are modified leaflets; whilst the Scarlet Runner (*Phaseolus*) has a twining (left-handed) stem by which it climbs erect slender supports. The Papilionaceæ have on their roots peculiar swellings or tubercles, which are caused by microscopic fungi. The compound leaves of many types display day- and night- movements.

ROSACEAE (Rose Family)

Herbs or shrubs. Leaves usually alternate, stipulate. Flowers regular, usually perigynous. Sepals usually 4 or 5. Petals usually 4 or 5, polypetalous. Stamens usually numerous, bent inwards in the bud. Carpels, from 1 to ∞, usually apocarpous, usually superior; styles more or less separate; often 1 or 2 ovules in each carpel. Fruit various. Seeds with very little or no endosperm.

TYPE I.: DOG ROSE (*Rosa canina*).*

Vegetative characters.—Shrub, with numerous prickles, which are "subsidiary outgrowths." Leaves alternate, with persistent stipules, pinnately compound with a terminal leaflet; margins of the leaf saw-like (serrate). **Inflorescence** terminal; the flower terminates a branch; in addition, one or two subjacent bracts may have a flower in the axil of each. [Look for the transitions between the foliage-leaves and bracts.] **Flower** (fig. 168) actinomorphic, ☿, cyclic; coloured and scented. *Sepals* (*cal*) five. The sepals are imbricate in the bud. The two external sepals have "beards" on both lateral

* Any Rose, save a double variety, may be selected for examination.

margins; a third sepal has one exposed margin which is

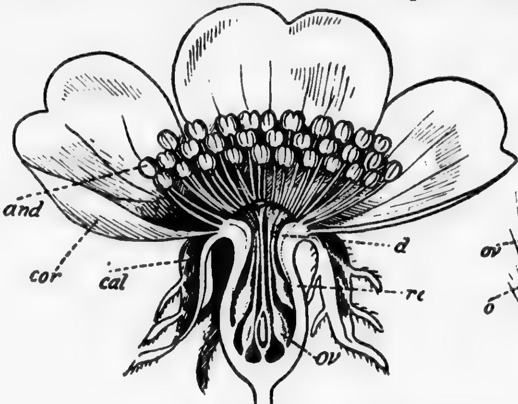

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Fig. 168.—Vertical section of flower of Dog Rose.
Fig. 169.—A carpel of ditto, with the ovary cut down the centre.

bearded, and the other margin concealed and not bearded (entire); finally, the fourth and fifth sepals are completely overlapped by the others, and have both margins even. *Petals* (*cor*) five, separate. *Stamens* (*and*) numerous, perigynous, curved inwards in the flower-bud. *Receptacle* (*rc*) [often termed the *calyx-tube*] deeply hollowed, so as to be urn-shaped, with its opening narrowed above. The sepals, petals, and stamens are inserted round the margin of the opening; they are all perigynous. A *disk* (*d*) clothes the lips and coats the lining of the receptacle-tube above the insertion of the carpels. The disk has not been seen to pour out honey. *Carpels* numerous, apocarpous; the many separate ovaries (*ov*) are concealed inside tube of the receptacle, and are inserted on its base and sides. They are superior, because they are not indistinguishably fused with

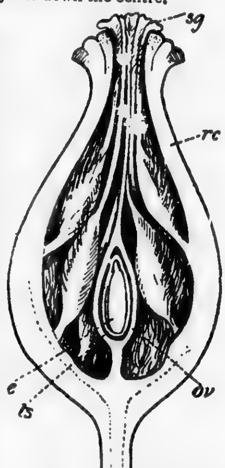

Fig. 170.—Vertical section of compound fruit of Dog Rose: *ov* = pericarp of a simple fruit; *ts*= testa of seed; *e*=embryo *rc*=concave receptacle.

the receptacle. Each one-chambered ovary (fig. 169, *ov*) contains one ovule (*o*), and is surmounted by a single style (*st*), which emerges through the mouth of the receptacular tube and bears a simple stigma (*sg*). **Fruit** (fig. 170) compound, consisting of numerous achenes concealed in the red hollowed receptacle, which bears a persistent calyx. (Each achene is, of course, developed from one of the separate carpels.) **Seeds** having no endosperm. **Dissemination.**—The achenes are scattered by the agency of birds, which peck at the red receptacle and incidentally dislodge the achenes. The red colour serves to render the fruit easily visible to birds.

Type II.: STRAWBERRY (*Fragaria vesca*).

The floral formula is the same as for the Rose, K5 C5 A ∞ G ∞. Beneath the calyx, and alternating with the sepals, is a whorl of sepal-like members which forms an epicalyx (fig. 82). The epicalyx represents, in this case, the stipules of the sepals, which have joined together in pairs. The shape of the receptacle is curious (compare fig. 173, representing the Blackberry flower), it is like a shallow saucer (*rc*) with a large lump (*rp*) rising from its centre. The sepals, petals, and stamens are attached to the rim of the saucer, and are therefore perigynous. Numerous apocarpous carpels are inserted on the central outgrowth. The *disk* (*d*) is like a ring, and lines the space between the rim of the saucer and the place of attachment of the central swelling; it excretes honey, and is a nectary. Each carpel (fig. 171) has its style (*sy*) attached to the side of the ovary (*ov*). The ovary contains one ovule (*o*). **Fruit** (fig. 172).—After pollination, the central mass of the receptacle (*rc*) enlarges greatly, becomes first white in colour, and finally changes into the red, sweet, juicy "strawberry" which we eat. Each carpel remains small and forms an achene (*ac*) with one seed (*s*) inside it. The complete **fruit** of the Strawberry is compound, and consists of many achenes

Fig. 171.—A carpel of Strawberry, showing the ovary cut down the middle.

Fig. 172.—Vertical section of compound fruit of Strawberry.

inserted upon an enlarged fleshy receptacle, to which the calyx (*sp*) and epicalyx (*ep*) still adhere. **Dissemination.**—The fruits are dispersed by birds, which eat the juicy receptacle and incidentally swallow the little dry achenes. These achenes have indigestible hard pericarps, and consequently pass uninjured through the bird's body. **Vegetative characters** (fig. 54).—Note the "runners," also the stipulate leaves with three leaflets.

TYPES III.: BLACKBERRY (*Rubus fruticosus*) AND RASPBERRY (*Rubus idæus*).

The flowers (fig. 173) are structurally very like those of the Strawberry, the only important distinctions being that there is

Fig. 173.—Vertical section of flower of Blackberry (in the figure, the terminal part of the receptacle (*rp*) drawn more spherical than it is in reality).
Fig. 174.—Cross-section of a single ovary of ditto.

no epicalyx, and the carpels contain two ovules each (fig. 174). After pollination the behaviour is different, however. The central outgrowth (*rp*) of the receptacle which bears the carpels does not develop into a large fleshy mass; it remains relatively small. But the carpels enlarge considerably and become one-seeded stone-fruits (drupes), which conceal the receptacular lump in their midst. Thus the fruit (fig. 175) of the Blackberry or Raspberry is compound: it consists of a collection of small stone-fruits (*d*) inserted upon a receptacle which bears also a persistent calyx (*sp*). **Dissemination.**—The

fruits are distributed by birds in the same manner as in the

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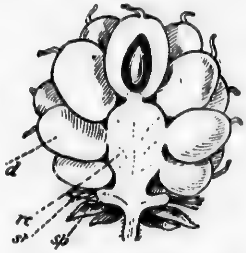

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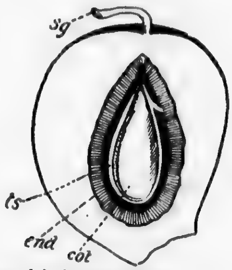


Fig. 175.—Vertical section of compound fruit of Blackberry: *sp*=sepals; *st*=shrivelled stamens; *d*=drupes.
Fig. 176.—Vertical section of a single drupe of ditto: *end* =stony layer of pericarp; *ts*=testa of the seed; *cot*=cotyledons.

Strawberry, but the stony endocarps (fig. 176, *end*) protect the seeds.

Types IV.: CHERRY, PLUM, and APRICOT (*Prunus*).

Prunus (including the Cherry, Plums, and Apricot) has flowers (fig. 177) constructed on the same plan as those of the Rose; but there is only one carpel, containing two ovules, at the bottom of the deep receptacular tube (*rc*) of each flower. After pollination great differences in the behaviour of *Prunus* and of the Rose set in. The receptacle-tube of *Prunus* drops off, and the single carpel grows greatly and becomes a one-seeded stone-fruit

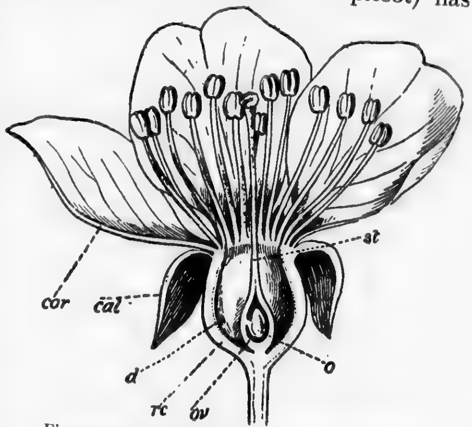


Fig. 177.—Vertical section of flower of Cherry.

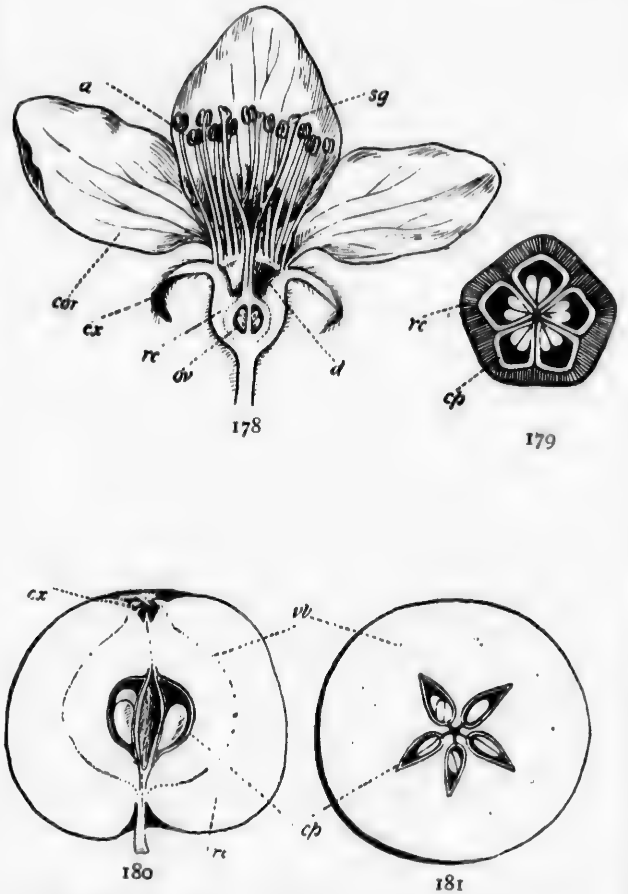
(drupe) (fig. 128). Thus the fruit is simple, and consists of one drupe. The stipules of *Prunus* are not persistent, but drop off.

TABLE SHOWING SOME DISTINCTIONS BETWEEN DIFFERENT SPECIES OF *Prunus*.

I. Leaves rolled (convolute) in the bud.	(*a*) Fruit smooth, with "bloom."	Plums (*Prunus domestica*).
	(*b*) Fruit velvety, yellow.	—Apricot (*Prunus armeniaca*).
II. Leaves folded (conduplicate) in the bud.	(*a*) Fruit black, red, or yellow, smooth, without "bloom."	Cherry (*Prunus cerasus*).
	(*b*) Fruit more or less greenish, usually velvety.	Peach (*Prunus persica*). (A smooth variety of the Peach is known as the Nectarine.)

TYPES V.: APPLE AND PEAR (*Pyrus*): VI.: HAWTHORN (*Cratægus*).

The genus *Pyrus* includes both Apples and Pears. The **flower** (fig. 178) of *Pyrus* possesses five sepals (*cx*), five petals (*cor*), numerous stamens (*a*), and usually five carpels (fig. 179 *cp*). Not only is the receptacle (*rc*) hollowed to form a cup (as in the Rose), but the outer faces of the carpels are fused with the lining of the receptacle-tube. Thus the flower is markedly epigynous. The five carpels are also united to one another by their sides, and, at the most, are only free from each other along their ventral sutures and styles; consequently, a five-chambered inferior ovary is produced. In the flower of the Pear the five styles are separate, but in the Apple the styles are united at their bases. Each of the five ovary-chambers contains not more than two ovules. As the **fruit** (figs. 180, 181, 182) ripens, the lining of each chamber of the ovary becomes a parchment-like endocarp (*cp*). The portion (*rc*) lying outside this core of five endocarps enlarges greatly, and is responsible for the production of the large, fleshy part of the Apple or Pear fruit. The fruit is a peculiar inferior fruit known as a pome. **Dissemination.**—The fruits are adapted



Figs. 178-181.—Apple. Fig. 178.—Vertical section of flower. Fig. 180.—Ditto of fruit. Fig. 179.—Cross-section of ovary. Fig. 181.—Ditto of fruit.

to invite the visits of fruit-eating beasts, which inadvertently swallow the seeds as they eat the fleshy parts of the fruit.

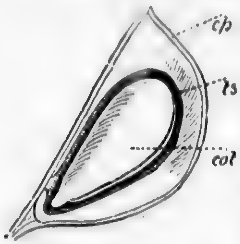


Fig. 182.—A parchment-like chamber removed from fruit of apple, containing a seed: *ts*=testa of seed; *cot*=cotyledons.

The Hawthorn (*Cratægus oxyacantha*) has flowers very similar in plan to those of the Apple and Pear; but the ovary consists of two carpels only, and has two chambers. In the fruit the endocarp around each chamber becomes hard and stony (not parchment-like), so that the fruit is a stone-fruit with two stones. Birds are responsible for the distribution of these red fruits, which are commonly called "haws" or Hawthorn-berries (though they are really stone-fruits). The leaves (fig. 58) have large stipules (*n*), and in the axils of some leaves protective thorn-branches (*d*) arise.

UMBELLIFERÆ (Parsley Family)

Herbs. Leaves alternate. Inflorescence simple or compound umbel. Flower usually regular, cyclic, epigynous, small. Sepals five or none, small. Petals five, polypetalous. Stamens five. Carpels two, syncarpous; ovary inferior, two-chambered, with one ovule in each chamber; styles two. Disk, epigynous. Fruit a schizocarp.

There is such a uniformity in the general habit of the Umbelliferæ, and in the structure of their flowers and fruits, that it is unnecessary to select any particular type. The CARROT (*Daucus carota*), the COW-PARSNIP (*Heracleum sphondylium*) may be mentioned as easily obtainable and recognisable.

Vegetative characters.—The stems are hollow. The leaves are alternate, deeply divided, with broad large sheaths. **Inflorescence** a compound umbel. There is usually a general involucre at the base of the whole inflorescence (main umbel), and also small involucres at the bases of the secondary (partial) umbels. In some plants the axis of an umbel ends in a flower which differs in colour from the rest of the flowers. In the Carrot this central flower is red, whereas the other flowers are white. **Flower.**—Usually ☿, usually actinomorphic, cyclic, usually white or yellow. Floral formula is K5 C5 A5 $G(\overline{2})$. In

the Cow-parsnip, and to a less degree in the Carrot, the flowers (fig. 183) at the margin of the inflorescence are zygomorphic by

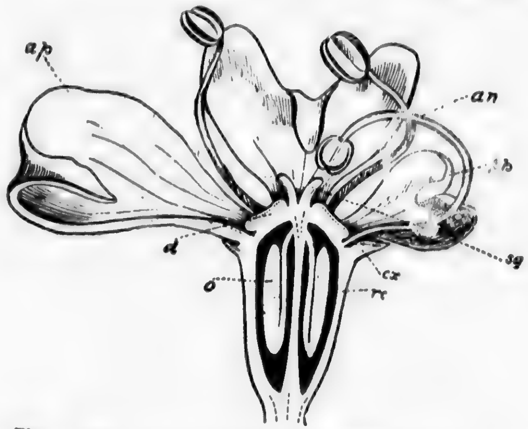


Fig. 183.—Vertical section of a marginal zygomorphic flower of *Heracleum sphondylium*.

reason of the special enlargement of the anterior petals (*ap*), which are directed outwards. *Sepals* (*cx*) five or none; when present the calyx is small, and is only represented by five teeth; in some Umbelliferæ the calyx is absent. *Petals* (*ap*, *pp*), five, separate, often bent inwards at their tips. *Stamens* (*an*) five, epigynous, separate, alternate with the petals, bent inwards in the bud. *Carpels* two, syncarpous, inferior; ovary two-chambered, with one ovule in each chamber; styles two, short. *Disk.*—The fleshy disk (*d*) lies on the roof of the ovary chamber, and the styles appear to emerge from this disk. The disk is a nectary. **Fruit.**—The fruit (figs. 185, 186) is a schizocarp splitting into two one-seeded closed mericarps, which remain for a time attached to the persistent thin portion of the axis (*ch*) (*carpophore*) of the fruit. The

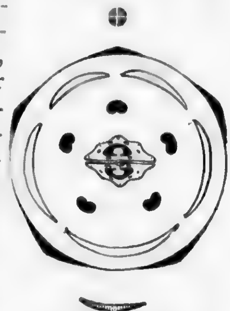


Fig. 184.—Floral diagram of zygomorphic flower of *Heracleum sphondylium*.

fruits have oil canals (v) in their walls which are ribbed. The oil-canals of the mericarps of the Cow-parsnip are of a characteristic club-shape (v). **Seed** (sd) endospermic. **Pollination.**—The flowers are small, and therefore not conspicuous, but they are crowded together in order to form a showy mass of bloom which shall serve to attract the notice of insects. In the Cow-parsnip this showiness is further enhanced by the enlargement of the petals at the margin of the inflorescence.

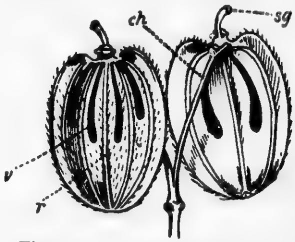


Fig. 185. — Fruit (schizocarp) of *Heracleum sphondylium*: r=ribs; v=oil-canals; sg=stigma; ch = carpophore.

The flowers are for the most part regular, with honey so freely exposed that insects possessing even the shortest tongues can sip at the honey. The consequence is that these flowers are largely visited and cross-pollinated by short-tongued insects, especially by flies, beetles, and wasps; but are largely neglected by long-tongued insects, such as moths and butterflies.

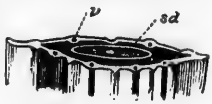


Fig. 186. — Part of mericarp of *Heracleum sphondylium* cut across: sd=seed.

USES, PECULIARITIES, ETC., OF UMBELLIFERÆ.

The Carrot and Parsnip (*Pastinaca*) are cultivated for the sake of their large tap-roots; Parsley (*Petroselinum*) for its green leaves; Celery (*Apium graveolens*) for its partially etiolated leaf-stalks and stem-base. The Hemlock (*Conium*) and some other Umbelliferæ are poisonous.

PRIMULACEÆ (Primrose Family)

Herbs. Flowers regular, hypogynous, often showy. Sepals five, gamosepalous. Petals usually five, gamopetalous. Stamens usually five, opposite the petals, epipetalous. Carpels superior, syncarpous; ovary one-chambered, with many ovules on a free-central placenta; style one; stigma simple. Fruit a capsule.

TYPE I.: PRIMROSE (*Primula vulgaris*).

Vegetative characters.—Perennial herb with a stout vertical rhizome. Leaves radical, exstipulate, simple. **Inflorescence**

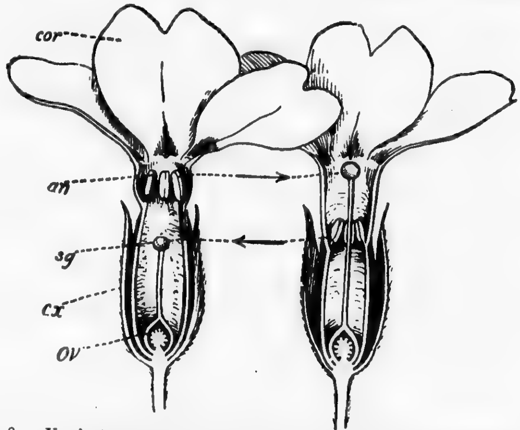


Fig. 187.—Vertical sections of the two forms of flowers of Primrose, showing the corresponding positions of anthers and stigmas.

an umbel at the summit of a bare inflorescence-axis. Bracts are present, but there are no prophylls on the flower-stalks. **Flower** (fig. 187) actinomorphic, ☿, cyclic, hypogynous. Two different forms of flowers occur on different individuals. *Sepals* (*cx*) five, combined. *Petals* (*cor*) five, combined to form a corolla with a long tube. Stamens five, inserted on the corolla. The five stamens are opposite (not alternate with) the five petals. Anthers with introrse dehiscence. *Carpels* five, syncarpous, superior. Ovary (*ov*) one-chambered, with many campylotropous ovules on a free-central placenta. Style one. Stigma knob-like. As there is only one style, a simple stigma, and the ovary is one-chambered with a central placenta, it be-

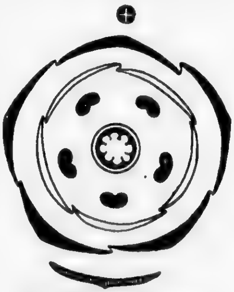


Fig. 188.—Floral diagram of Primrose.

comes a matter of difficulty to prove that there are five carpels. The facts that the capsule opens by five double-teeth, and that in "monstrous" flowers five leaves often replace the single gynæcium, suggest that the gynæcium represents five carpels. **Fruit** (fig. 189) a capsule dehiscing by five double-teeth. **Seeds** shield-like in shape, endospermic. **Pollination.**—The flowers of some Primrose plants have stamens inserted in the throat of the corolla, so that the five anthers form a circle just within the mouth of the corolla-tube; in these flowers the style is short, the stigma is hidden deep down in the corolla-tube: this is the *short-styled form* of flower (fig. 187, left-hand figure). In other plants the relative positions of the anthers and stigma are just reversed, and a long style raises the stigma to the mouth of the corolla-tube, whilst the shortness of the filaments and their insertion lower down the corolla-tube cause the anthers to be hidden inside the tube: this is the *long-styled form* of flower (fig. 187, right-hand figure). Comparing the two forms of flowers, we see that the anthers of one form stand at just the same level up the corolla-tube as does the stigma of the other form (see fig. 187). Honey is excreted by the base of the ovary. An insect with a sufficiently long tongue, when it goes from one form of flower to the other, will accurately transfer the pollen from the anthers of the one on to the stigma of the other in each case, because the pollen is deposited on a particular part of the insect's tongue. Spontaneous self-pollination is possible in the short-styled form.

Fig. 189.—Fruit of Primrose.

Type II.: POOR-MAN'S WEATHER-GLASS

(*Anagallis arvensis*).

A small annual herb with red flowers. [There are very few British plants with red flowers.] Flowers solitary in the leaf-axils. The flowers are constructed on the same plan as in the Primrose, but with a shortened tube: K5 C5 A5 G$\underline{(5)}$. There

is only one form of flower however. The fruit (fig. 125) is a capsule with transverse dehiscence. **Pollination.**—The flower closes in dull weather; it also opens by day and shuts in the evening. It has no honey, but is visited for the sake of its pollen. If it has not been cross-pollinated after opening regularly for three days, the flower finally closes, and the stigma is brought into contact with anthers which are coated with pollen. Thus self-pollination is inevitable in the absence of cross-pollination.

CONVOLVULACEÆ (Convolvulus Family)

Twining herbs with alternate, simple, exstipulate leaves. Flower regular, hypogynous. Sepals five. Petals five, gamopetalous. Stamens five, epipetalous. Carpels two, syncarpous, superior; ovary usually two-chambered, with two ovules in each chamber; style two-branched; stigmas two. Fruit a capsule.

TYPE I.: BINDWEEDS (CONVOLVULUS).

In addition to the family characters given above, the following are worthy of note:—*Convolvulus* twines in a left-handed direction (fig. 56). **Flower.**—*Sepals* five, separate. *Petals* five, combined, plaited and contorted in the bud. *Stamens* five, with anthers shaped like arrow-heads. *Ovary* two-chambered, with two ovules attached to the base of each chamber. *Disk* ring-like with angles, and surrounding the base of the ovary: it secretes honey. The flowers close in the evening.

SOLANACEÆ (Potato Family)

Herbs. Leaves alternate or paired, exstipulate. Flower usually regular, cyclic, hypogynous. Sepals five. Petals five, gamopetalous. Stamens five, epipetalous. Carpels two, syncarpous, superior; ovary two-chambered, with many ovules on an axile placenta.

TYPE: NIGHTSHADE (*Solanum nigrum*).

Vegetative characters.—Annual herb. Leaves exstipulate, alternate, but near the flowering portion of the stem the leaves are seemingly arranged in pairs of one large leaf and one smaller one at a node. The branching is really cymose, and each inflorescence appears to spring from the side of the stem, yet not to arise in the axil of a leaf.* **Inflorescence** cymose; note that no prophylls are visible on the flower-stalks. **Flower** (fig. 84) actinomorphic, ☿, cyclic, hypogynous. *Sepals* (*cx*) five combined. *Petals* (*co*) five, combined. *Stamens* (*a*) five, alternating with the five petals and inserted on the corolla-tube; the anthers are close together in the centre of the flower, each opening by two pores at its summit. *Carpels* two, syncarpous, superior. Ovary (*ov*) two-chambered, with many ovules on a thick axile placenta. Style one. Stigma (*sg*) one. [Try and see that the two carpels are not median or transverse in position, but are oblique.] **Pollination.**—The flower has no nectary, but is visited for the sake of its pollen. **Fruit** a berry. **Seeds** kidney-shaped. **Dissemination.**—In spite of their being poisonous, the berries are eaten by birds, which consequently are responsible for the dispersal of the seeds.

Fig. 190.—Floral diagram of *Solanum*.

The Potato-plant (*Solanum tuberosum*) has flowers so similar to those of the Nightshade that they may be selected for examination in place of the latter. The plant is a perennial with subterranean tuberous shoots. The unequal size of the leaflets composing a leaf is specially worthy of note (fig. 48).

USES, PECULIARITIES, ETC. OF SOLANACEÆ.

Many Solanaceæ contain powerful poisons, some of which are used as medicines. Belladonna is obtained from *Atropa*

* This characteristic method of branching, and the peculiar paired arrangement of the leaves, cannot be explained in this book.

belladonna. The Tobacco-plant (*Nicotiana*) contains a poisonous alkaloid, nicotin. The Tomato (*Lycopersicum*) is cultivated for the sake of its fruits (berries). Cayenne pepper is obtained from the red fruits of *Capsicum*. Some Solanaceæ are ornamental plants grown in gardens—*e.g. Petunia, Datura* (with prickly capsules), *Nicotiana*.

BORAGINACEÆ (Forget-me-not Family)

Herbs, often with stiff hairs. Leaves alternate, entire, exstipulate. Inflorescence, a scorpioid cyme. Flowers regular, cyclic, hypogynous. Sepals five, gamosepalous. Petals five, gamopetalous. Stamens five, epipetalous. Carpels two, syncarpous, superior; ovary four-lobed, divided into four chambers each containing one ovule; style one, inserted between the four lobes of the ovary. Fruit a schizocarp separating into four nutlets.

TYPE: SCORPION GRASS, FORGET-ME-NOT (*Myosotis*).

The flowers exhibit the characters given above. In addition, we observe that the scorpioid cyme is a curved cyme looking like a raceme: the best method of regarding this inflorescence is to consider the axis as a sympode (see figs. 80, 81) made up of a number of monochasia (one-branched cymes). In each flower we note—(i.) Five little scales attached to the corolla and roofing over its mouth. These form the *corona* which protects the pollen and honey. (ii.) The five stamens are hidden in the corolla-tube, and have introrse anthers. (iii.) The honey is excreted by the fleshy base of the ovary and collects at the bottom of the corolla-tube.

The Heliotrope (*Heliotropium*), commonly cultivated in hot-houses, differs in having an ovary which is not lobed.

LABIATÆ (Dead Nettle Family)

Herbs or shrubs with four-sided stems. Leaves opposite, exstipulate. Inflorescences opposite, axillary, cymose clusters. Flower irregular, cyclic, hypogynous. Sepals five, gamosepalous. Petals five, gamopetalous, usually two-lipped. Stamens two or four, epipetalous; if there be four, two are longer and two shorter. Carpels two, syncarpous; ovary four-

lobed and divided into four chambers, each containing one ovule; style attached between the bases of the four lobes of the ovary. Fruit a schizocarp of from one to four nutlets.

Type: WHITE DEAD NETTLE (*Lamium album*).

Vegetative characters.—Perennial herb with a four-sided stem. Leaves opposite, exstipulate, with scalloped or saw-like margins. **Inflorescence.**—Each infloresence which stands in the axil of a leaf is a dichasium with a terminal flower and two lateral one-branched cymes (monochasia). **Flower** (fig. 191) median-zygomorphic, ☿, cyclic, hypogynous. *Sepals* (*cx*) five, combined. *Petals* (*pp*, *lp*, *ap*) five, combined to form a two-lipped corolla. In order to understand that there are five petals represented in the corolla, it is necessary first to remember that the petals alternate with the sepals. It will then be seen that the three-lobed lower lip represents one anterior petal (*ap*) and two lateral petals (*lp*) alternating with two anterior sepals. In like manner the upper lip of the corolla represents two posterior petals (*pp*), one on each side of the median posterior sepal (see diagram fig. 192). The slight notch in the apex of the upper lip also denotes that the latter represents two closely joined petals. A ring of hairs (*h*) lines a zone of the corolla-tube. *Stamens* four, the two anterior stamens having longer filaments than the other pair, inserted on the corolla. In order to understand the andrœcium we must again remember that the stamens should alternate with the petals. There should, therefore, be a median posterior stamen, but no such stamen is present. We therefore conclude that the median posterior stamen has been suppressed:

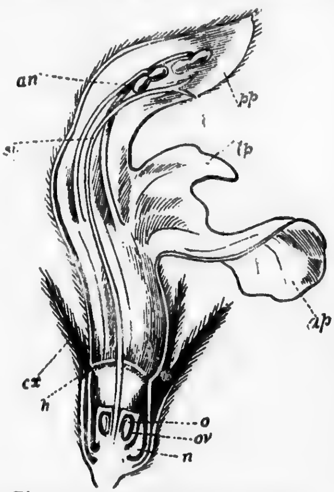


Fig. 191.—Vertical section of flower of Dead Nettle.

and the other four stamens alternate with the petals (see diagram). The anthers are in pairs close together under the arching upper lip of the corolla: they have peculiar diverging anther-lobes. *Carpels* two, syncarpous, superior. The ovary (*ov*) is four-lobed and divided into four chambers, each with one ovule (*o*). The style is attached to the ovary at the base of the junctions of the four lobes: it (*sy*) is single, but forks above and is capped by two stigmas. The two stigmas indicate that only two carpels are represented in the gynæcium. Thus the ovary should be two-chambered, but each chamber is further divided into two halves by a false septum. The two stigmas are median in position, thus indicating the two carpels are median. *Nectary* (*n*) a fleshy hypogynous outgrowth of the receptacle lying at the anterior face of the ovary. **Fruit.** — Each chamber of the ovary becomes a one-seeded indehiscent nut-like body (nutlet). The fruit may be described as a peculiar schizocarp. **Pollination.**—We note—(i.) The flowers are not erect but point obliquely upwards, and are median-zygomorphic. (ii.) The upper lip protects the pollen and honey from rain. (iii.) The honey is deeply placed and concealed; it collects at the bottom of the corolla-tube. A ring of hairs in the latter acts as a rampart to protect the honey from marauding insects which would not effect cross-pollination. (iv.) The flower is specially adapted for cross-pollination by the agency of humble-bees. The humble-bee alights on the middle lobe of the lower lip, pushes its head down the tube in order to reach the honey which is at the anterior face of the ovary. The back of the bee thus comes into contact, first with the anterior stigma, and immediately afterwards with the anthers. The consequence is, that pollen lodged on the bee's back by a previously visited flower is conveyed to the stigma of a flower before the pollen of this latter is touched by the humble-bee; and cross-pollination results. We note how perfectly the humble-bee fits into

Fig. 192.—Floral diagram of Dead Nettle.

the flower. This flower is a good example of one which is pollinated by pollen conveyed on the back of a bee. In the Pea-family, on the other hand, the pollen is transferred from flower to flower on the under surface of the bee's body. In accordance with this we observe that in the Dead Nettle the honey is accessible on the lower (anterior) face of the ovary, and the bee has, so to speak, to crouch down to obtain the honey; whereas in the Pea the honey can only be reached on the upper (posterior) face of the ovary. In both the Pea and the Dead Nettle the anterior part of the corolla acts as a platform on which the bee alights. The Purple Dead Nettle has a corolla with a shorter tube, and may be pollinated by ordinary bees, as well as by humble-bees.

USES, ETC. OF LABIATÆ.

Many Labiatæ contain odorous ethereal oils which are used for various purposes. Ethereal oils of Peppermint and Thyme are familiar. Thyme (*Thymus*), Mint (*Mentha*), Sage (*Salvia*) are used for culinary purposes, and their aroma is due to the ethereal oils which they possess.

SCROPHULARIACEÆ (Foxglove Family)

Herbs. Flowers irregular, cyclic, hypogynous. Sepals five, gamosepalous. Petals five, gamopetalous, often two-lipped. Stamens usually four, often two shorter, two longer (sometimes two or five), epipetalous. Carpels two, syncarpous, superior; ovary, two-chambered, with many ovules on an axile placenta; style one. Fruit usually a capsule.

TYPE I.: FOXGLOVE (*Digitalis purpurea*).

Vegetative characters.—Tall herb. Leaves: lower ones radical, crowded and stalked; upper ones alternate, sessile. **Inflorescence** a terminal raceme. **Flower** (fig. 193) median-zygomorphic, ☿, cyclic, hypogynous. *Sepals* (*ps*, *cx*) five, combined. *Petals* (*cor*) five, combined to form a large tube with five short, broad, free lobes; the anterior part of the corolla (lower lip) is longer than the posterior portion (upper lip). The corolla is spotted. *Stamens* (*an*) four, attached to the corolla, two stamens with longer filaments

than the other two; the medium posterior stamen is absent (see Labiatæ for method of proof); anthers inclined together in pairs, and with divergent lobes. *Disk* (*n*) forms a ring round the base of the ovary; it is a nectary. *Carpels* two, syncarpous, superior. Ovary (*ov*) two-chambered, with numerous ovules on an axile placenta. Style (*sy*) one. Stigma two-lobed. The

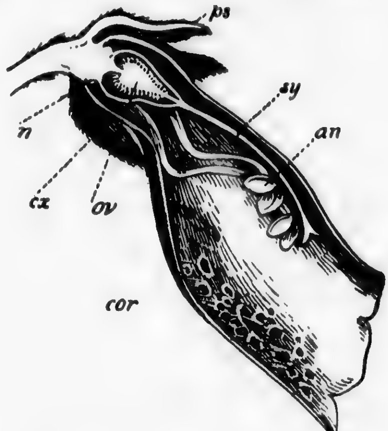


Fig. 193.—Vertical section of flower of Foxglove.

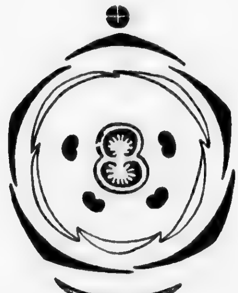


Fig. 194.—Floral diagram of Foxglove.

carpels are median in position. **Fruit** (fig. 123) a two-valved capsule, leaving the numerous seeds attached to the thick axile placenta (*pl*). **Pollination.**—The stamens dehisce before the gynæcium is ripe: that is, the flower is *proterandrous.* The flowers are cross-pollinated by the agency of humble-bees only. The humble-bee creeps bodily into the flower (we notice that it just fits the flower), and its back comes into contact with the stigma-lobes and anthers. Thus, as in the Dead Nettle, the pollen is conveyed from flower to flower on the back of the bee.

THE SUPPRESSION OF STAMENS IN THE SCROPHULARIACEÆ.

The andrœcium of different Scrophulariaceæ is interesting in showing the gradual suppression of special stamens. The Mullein (*Verbascum*) has a nearly regular flower with five stamens, which alternate with the five petals (fig. 195). The Snapdragon

(*Antirrhinum*) and the Toadflax (*Linaria*), with irregular flowers, have four stamens, alternating with petals, and in addition they may have a fifth stamen, which is smaller, and is median posterior in position (fig. 196); in the Figwort (*Scrophularia*) the same arrangement is found, but the median posterior stamen exists in the form of a scale-like staminode. In the Foxglove and many other types the posterior stamen has completely disappeared, so that only four stamens are present (fig. 197). Finally, in the Speedwell (*Veronica*) the two anterior stamens have also vanished, so that the flower possesses only two lateral stamens (fig. 198). The flower of the Speedwell is not two-lipped; it has a very short corolla-tube, and the two posterior petals are so closely united as to look like a single petal.

195 196 197 198

Figs. 195-198.—Diagrams of the andrœcium of Scrophulariaceæ.

THE SHAPES OF SCROPHULARIACEOUS FLOWERS AND THE INSECTS POLLINATING THEM.

In the Scrophulariaceæ we can see that the varied forms of flowers pollinated by insects are to be explained by observing the insects which pollinate them. The Speedwell (*Veronica chamædrys*), with open small flowers, having a very short corolla-tube and easily accessible honey, is especially cross-pollinated by certain flies—hover-flies: it is a *Hover-fly-flower*. The Figwort (*Scrophularia*), with short, wide chocolate-coloured flowers, and easily visible honey, is particularly cross-pollinated by wasps: it is a *Wasp-flower*. The Foxglove, Snapdragon, and Toadflax possess flowers with long corolla-tubes and deeply-placed honey; the visiting insect creeps bodily into the tube, and its body must fit the flower if cross-pollination is to be ensured; thus large-bodied bees are the sole cross-pollinating agents: they are *Bee-flowers*, especially Large-bee-flowers. The Snapdragon-flower is closed, so that only a strong insect can push its way in and reach the honey; the pollen and honey are consequently well protected against rain and marauding insects.

CAPRIFOLIACEÆ (Honeysuckle Family)

Shrubs or herbs. Leaves opposite, exstipulate, or with minute stipules. Flowers regular or irregular, cyclic, epigynous. Sepals five, small, gamosepalous (with three to five lobes). Petals five, gamopetalous. Stamens five, epipetalous. Carpels usually three (three to five), syncarpous, inferior; ovary with one or several chambers, containing one or more ovules. Seeds endospermic.

TYPE I.: HONEYSUCKLE (*Lonicera periclymemum*).

Vegetative characters.—Woody climber with opposite exstipulate leaves. **Inflorescence.**—Head-like cymes terminate a number of the upper branches; small bracts are present. **Flower** (fig. 199) median-zygomorphic, two-lipped, ☿, cyclic, epigynous. *Sepals* five, combined to form a five-toothed calyx (*cx*). *Petals* five, combined to form a corolla with a very long

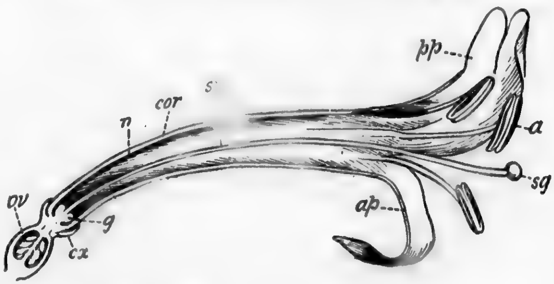


Fig. 199.—Median vertical section of flower of Honeysuckle : *g*=disk.

tube (*cor*), and two lips; the upper lip has four teeth, and therefore represents four petals (*pp*); the lower lip is not toothed, and represents the single anterior petal (*ap*). *Stamens* (*a*) five, inserted on the corolla-tube, alternating with the petals. *Carpels* three, syncarpous, inferior. Ovary (*ov*) three chambered, with several ovules in each chamber on an axile placenta. Style one. The style (*sy*) is very long, and brings the stigma far beyond the mouth of the corolla-tube. Stigma (*sg*) knob-like. **Fruit,** a red berry, containing a few seeds. Note that the head of flowers forms a cluster of fruits (in-

fructescence, fig. 201). **Pollination.**—The honey is secreted along the posterior middle line of the corolla (*n*) by the fleshy part of the base of the tube, and collects there. As the corolla-tube is long, the honey can be fully reached only

Fig. 200.—Floral diagram of Honeysuckle.

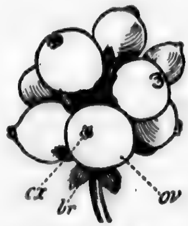


Fig. 201.—Infructescence of Honeysuckle: *br* = bracts; *cx* = calyx of each fruit (*ov*).

by insects with very long tongues—that is, solely by butterflies and moths. The flower is cross-pollinated chiefly by the night-flying hawk-moths. The light colour and sweet scent, especially strong at night time, serve to attract the notice of moths. The position of the stigma obviously renders self-pollination by the flower itself well-nigh impossible. [Endeavour to follow out the dehiscence and movements of the stamens.]

Types II. and III.: The ELDER (*Sambucus nigra*) and GUELDER-ROSE (*Viburnum opulus*).

Although the flowers of these two plants are constructed on the same general plan (K5 C5 A5 $\overline{G(3)}$) as those of the Honeysuckle, they differ from the latter very widely as regards their shapes. Their flowers are erect and regular, and their corolla-tubes are very short. Accordingly, we find that their insect-visitors are widely different from those of the Honeysuckle. The honey is freely exposed in the Guelder-Rose, whilst the Elder flowers, though they secrete no honey, are highly-scented, and are visited by insects desiring their pollen. Thus, in both these plants, the insect-food is very easily accessible; and the chief pollinating agents are short-tongued beetles and flies.

The seed-producing flowers of both plants are small and relatively inconspicuous; yet, being grouped together, they form showy masses of bloom. The inflorescence of the Guelder-Rose consists of two kinds of flowers: (i.) Those in the centre, which are normal in structure, each being endowed with perfect stamens and carpels, and a small regular corolla; (ii.) others ranged round the margins of the inflorescence, having their stamens and carpels so reduced as to be useless, yet each possessing a large and conspicuous corolla. The marginal flowers are incapable of taking any direct share in the production of seeds; their sole office is to attract insects to the central blossoms, which alone make seeds. The "Snowball Tree" is an artificial variety of the Guelder-Rose: all its flowers are changed into the non-productive marginal flowers with showy corollas.

COMPOSITÆ (Daisy Family)

Herbs, rarely shrubs. Leaves exstipulate. Inflorescence a capitulum with an involucre. Flowers small, regular or irregular, cyclic, epigynous. Sepals small or absent, sometimes replaced by a pappus. Petals five (or four), gamopetalous, valvate in the bud. Stamens five (or four), epipetalous; anthers united. Carpels two, syncarpous, inferior; ovary one-chambered, with one basal ovule. Seeds non-endospermic.

Type I.: DANDELION (*Taraxacum officinale*).

Vegetative characters.—A perennial herb containing a milky juice, with simple radical leaves, and a bare inflorescence-axis terminating in a capitulum. The Dandelion has a tap-root surmounted by a short erect rhizome. The rhizome is a sympode. Each year the visible axis, which bears the radical leaves at its base and terminates in an inflorescence, dies down nearly to its base. A bud in the axil of one of the radical leaves on this persistent basal part grows out the following year, and produces a similar radical tuft of leaves and a terminal inflorescence. This in turn dies down to near its base, and an axillary bud on it grows up in the next year to produce a new flowering axis. Thus the rhizome is made up of the persistent bases of all these successive branches strung together to form a false axis or sympode. The rhizome is pulled

underground by the contraction of the roots, and consequently the leaves are, in each year, pressed close to the surface of the soil. **Inflorescence** (fig. 253).—The part which is popularly spoken of as the "Dandelion-flower" is an inflorescence, and consists of many (100 to 200) flowers inserted close together on a dilated terminal part of the stem. This statement is easily proved by pulling out one of the flowers from the capitulum, and seeing that it consists of successive whorls of floral leaves. The inflorescence-axis bears, immediately beneath the insertion of the flowers, a number of bracts forming an involucre, which surrounds the collection of flowers. The dilated terminal part of the inflorescence-axis is often termed the "receptacle"; but it must be remembered that this has no connection with the receptacle of a single flower. Within the general involucre the central bracts have been suppressed; and only the outermost series of flowers stand in the axils of bracts which form the green involucre. The capitulum (figs. 253, 254) of the Dandelion displays movements. It closes in the evening or in dull weather, and opens in the morning or in sunlight. In addition, the inflorescence-axis executes certain movements

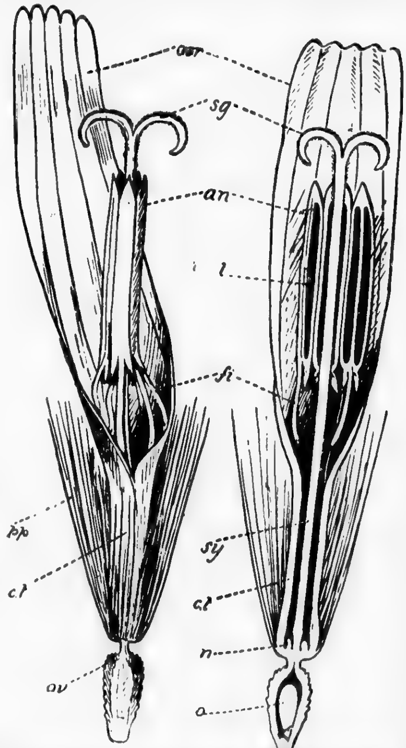


Fig. 202.—Flower of Dandelion. Left-hand figure is a complete flower: right-hand figure is a vertical section.

when flowering and fruiting. **Flower** (fig. 202) median-zygomorphic, ☿, cyclic, epigynous, yellow. *Calyx*, represented by a circlet of silky hairs forming the *pappus* (*pp*). *Petals* five, combined to form a corolla consisting of a short tube (*ct*), which expands on the anterior (outer) side into a strap-shaped lower lip (*cor*). The strap has five teeth at its termination, and thus shows that the corolla consists of five joined petals. In the central flowers of the capitulum the lower face of the strap is coloured like the upper face; but the lower face of the strap of the marginal flowers is of a darker tint than is the upper face. *Stamens* (*an*, *fi*) five, inserted on the corolla-tube; the five anthers (*an*) united to form a tube round the style. The anthers dehisce marginally in such a manner that the pollen is poured out towards the style, thus dehiscence is introrse. Each lobe of the anther has a small pointed tooth-like process from its lower end: the connective is also continued upwards to form a membranous curtain. The filaments (*fi*) are separate. *Carpels* two, syncarpous, inferior. Ovary (*ov*) one-chambered, with one basal ovule (*o*) standing up from the floor of the chamber. Style (*sy*) single, but forked above to form two branches bearing the stigmas (*sg*). The stigmas only line the upper faces of the two branches of the style. The circumstance that the style has two branches serves to denote that the gynæcium does not consist of one carpel only, but is constituted of two carpels and is syncarpous. Especially worthy of note are the hairs on the upper part of the style and on the lower (outer) parts of the branches of the style. *Nectary* (*n*) a ring-like disk round the base of the style. **Fruit** (fig. 129, left-hand).—The fruit is one-seeded and indehiscent (achene), and is surmounted by a long beak bearing a circlet of many silky hairs forming the pappus. If the pappus be regarded as a calyx, the fruit consists of an inferior ovary (with receptacle) and a persistent calyx (pappus). We note that the fruits together form a capitulum of fruits

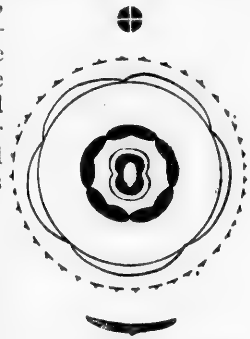
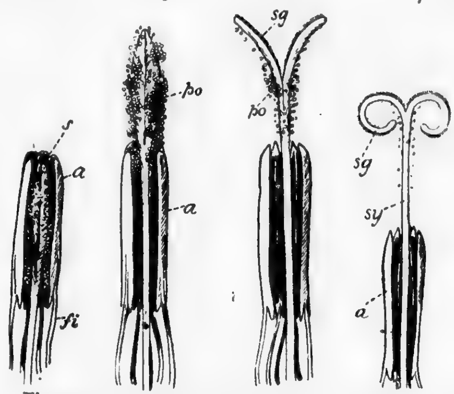


Fig. 203.—Floral diagram of Dandelion.

(fig. 129, right-hand): this collection is an infructescence (not a compound fruit), because it is formed by a number of flowers (not by one flower only). **Dissemination.**—The fruits are dispersed by the wind, and the pappus forms a parachute. **Pollination.** — The flowers are proterandrous. The anthers dehisce around the style before the latter has attained its full length, and whilst the two terminal arms of the style are still applied to each other (fig. 204). The style then elongates and the hairs on its sides brush the pollen out of the tube formed by the ring of anthers (fig. 205). Inasmuch as these hairs serve to hold and carry up the pollen, they are termed "collecting-hairs." The style thus acts like a brush employed in sweeping a chimney. Insects now visiting the flower to sip at the nectar touch the pollen thus carried up on the style. Soon the arms of the style separate and the stigmas on their upper faces are ready for the reception of pollen (fig. 206). An insect dusted with pollen, and visiting flowers at this later stage, will transfer pollen on to the stigma, and thus may effect cross-pollination. But if the stigmas are not pollinated, the branches of the style continue to curl downwards, and even execute complete curves at their ends, so that eventually they touch the collecting hairs (fig. 207), and are self-pollinated.

204 205 206 207



Figs. 204-207.—Diagrammatic figures of the behaviour of the anthers, style, and stigmas of Dandelion.

TYPES II., III., IV.: DAISY (*Bellis perennis*): SUNFLOWER (*Helianthus annuus*): OX-EYE DAISY (*Chrysanthemum leucanthemum*).

These three plants also have capitula of flowers (fig. 208), which differ from the Dandelion-heads in that they possess

two sorts of flowers. In the two Daisies the numerous central flowers—termed the *disk-flowers*—are yellow; whereas the marginal flowers—termed the *ray-flowers*—form a single white series immediately within the involucre. In the Sunflower the conspicuous ray-flowers are yellow, and form a single series

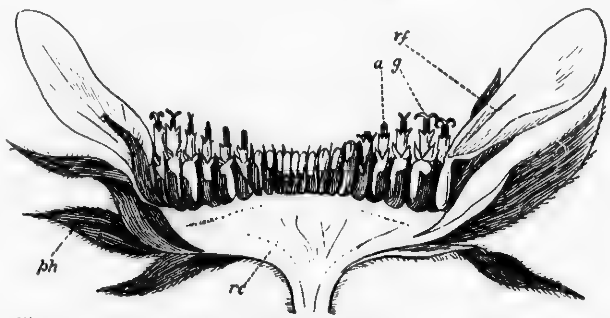


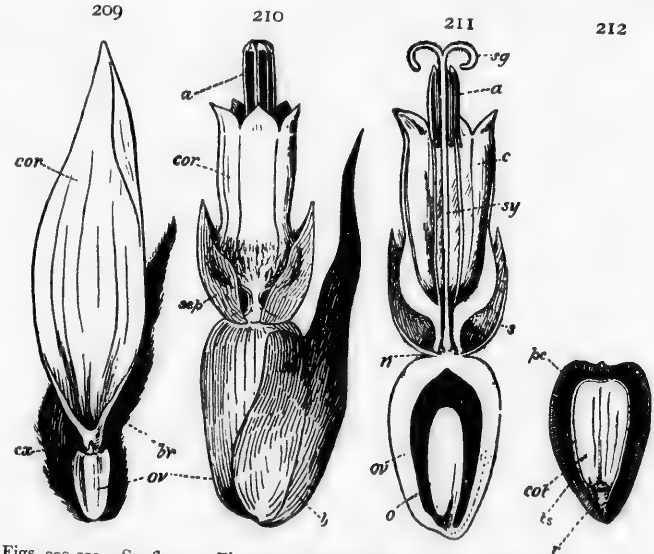
Fig. 208.—Vertical section of capitulum of Sunflower: *rc*=receptacle of inflorescence: *ph*=green bracts; *g*=disk flower with style, arms already protruding: *a*=younger disk flower, with anthers visible.

surrounding the central brown mass composed of innumerable little disk-flowers.

The **disk-flowers** (figs. 210, 211).—Each flower is regular, and has a tubular five-toothed corolla (*cor*), within which succeed five epipetalous stamens with united anthers (*a*); in the centre is a gynæcium (*ov, sy, sg*) like that of the Dandelion-flowers. There is no pappus in the two Daisies, but the calyx is represented by epigynous scales (*sep, s*) in the Sunflower. Thus in their general structure these flowers agree with those of the Dandelion, but they differ from the latter in being actinomorphic.

The **ray-flowers** (figs. 208 *rf*, 209), though superficially more like the flowers of the Dandelion, are in reality constructed on a different plan. Their calyx is absent in the case of the two kinds of Daisies, but in varieties of the Sunflower there are from one to five minute scales (*cx*). The corolla is tubular at the base, and represents at this point five petals (judging by comparisons with the other flowers); but above the tubular part, the three more anterior petals grow out to form a long strap. That the strap thus represents three petals is feebly denoted by its terminal teeth in the Ox-eye Daisy, but is much more

distinctly seen in some other species of *Chrysanthemum*, the straps of which have three terminal teeth. The straps of the Sunflower and Daisy are not toothed at their ends. Thus



Figs. 209-212.—Sunflower. Fig. 209.—Ray-flower. Fig. 210.—Disk-flower. Fig. 211.—Vertical section of Disk-flower. Fig. 212.—Vertical section of achene: *pc*=pericarp; *ts*=testa; *cot*=cotyledons; *r*=radicle.

the strap of the Dandelion represents five joined petals, and the flower may be described as a *true ligulate* (strap-like) *flower*; whereas the strap of the corolla belonging to the ray-flowers of the three other types represents only a part of the corolla (three petals), and may be referred to as a *false ligulate flower*. The ray-flowers of all three types possess no stamens; in the two Daisies they have a gynæcium, and are therefore carpellary flowers: but in the Sunflower they have no style and stigma, though an empty ovary-tube is present.

We note each disk-flower of the Sunflower arises in the axil of a scale-like bract (figs. 208, 210 *b*); whereas the inflorescence-receptacle of the two Daisies, like that of the Dandelion, only has those bracts which form the involucre.

Pollination.—Cross-pollination is accomplished much as in the Dandelion. The flowers are proterandrous, and the pollen is carried out of the corolla-tube of the disk-flowers by collecting-hairs on the unopened style. The hairs, however, are limited to the outer surfaces of the style-branches: and so long as these latter are not separated, the collecting-hairs form a tuft somewhat like a paint-brush. This terminal brush sweeps the pollen upwards. These collecting-hairs are absent from the style of the carpellary ray-flowers, because they are obviously useless to a flower which produces no pollen. The ray-flowers serve to make the inflorescences more conspicuous; in the Sunflower this is the only service they render to the plant (compare the Guelder-Rose).

TYPE V.: CORN-FLOWER (*Centaurea cyanus*).

The Corn-flower has no strap-like flowers. Its capitulum is composed solely of tubular flowers. The central flowers, though blue in colour, are very like the disk-flowers of the Daisy, but with a pappus of hairs. The marginal flowers are large, somewhat irregular, and are devoid of stamens, style, stigma, and ovules. **Pollination.**—The collecting-hairs are arranged on a globular swelling of the style just beneath the point at which the latter forks. In freshly-opened flowers the filaments of the stamens rapidly contract when the anthers are touched for the first time, and consequently the pollen is suddenly exposed on the collecting hairs.

GENERAL REMARKS ON THE COMPOSITÆ.

In examining the Compositæ the chief points to note are—(i.) The inflorescence-receptacle; its form; the presence or absence of scale-like bracts amongst the flowers. (ii.) The opening and closing movements of the capitulum. (iii.) The calyx and pappus. (iv.) The form of the corolla. (v.) The presence or absence of stamens and carpels in the flowers. (vi.) The occurrence or non-occurrence of an outgrowth of the connective, and of appendages of the anthers. (vii.) The arrangement of the stigma-lines on the arms of the style and the disposition of the collecting-hairs. (viii.) The presence or absence and the form of the pappus on the fruit.

Cultivated plants—Uses, etc.—The root of the Chicory (*Cichorium*) which has capitula of blue ligulate flowers, is the source of the substance "chicory," which is used in the adulteration of Coffee. The Lettuce (*Lactuca*) has yellow ligulate flowers. The tubers of the Jerusalem Artichoke (*Helianthus tuberosus*) are subterranean stems which are consumed as vegetables. But the "tubers" of the *Dahlia* are very thick adventitious roots. The Artichoke (*Cynara*) possesses fleshy capitula which are edible. The Marigold (*Calendula*) has carpellary disk-flowers, and staminate ray-flowers: it often produces several kinds of fruits in the same inflorescence. The so-called double varieties of *Dahlia*, and the cultivated varieties of *Chrysanthemum*, are plants whose disk-flowers have been artificially converted into false ligulate flowers. Other familiar garden plants are *Cineraria*, *Gaillardia*, *Calliopsis*, *Pyrethrum*, Everlasting Flowers (*Helichrysum*).

MONOCOTYLEDONS

LILIACEÆ (Lily Family)

Perennial herbs with bulbs or rhizomes. Flowers usually regular, hypogynous. Perianth 3 + 3, petaloid. Stamens 3 + 3. Carpels three, syncarpous, superior; ovary three-chambered; style usually single. Fruit, a capsule or berry.

TYPE: GARDEN HYACINTH (*Hyacinthus orientalis*).

Vegetative characters.—Perennial herb with a coated bulb (for description, see page 33, also fig. 53). Foliage-leaves radical, long, narrow, with sheathing bases, parallel-veined.

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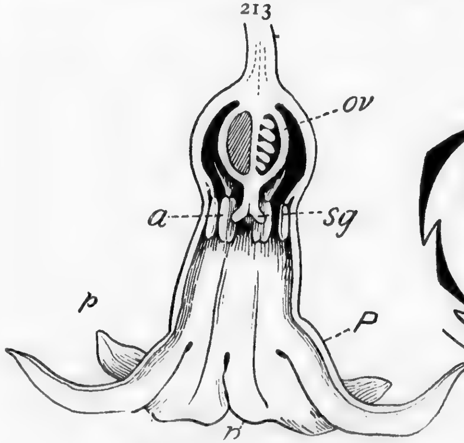

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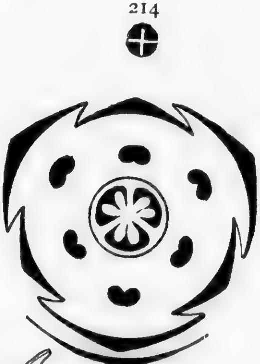

Fig. 213.—Vertical section of flower of garden Hyacinth.
Fig. 214.—Floral diagram of ditto.

Inflorescence.—A bare inflorescence-axis terminates in a raceme of pendulous flowers, which stand in the axils of small narrow

bracts. **Flower** (fig. 213) actinomorphic, ☿, cyclic, hypogynous. *Perianth* (P, p) 3 + 3, brightly coloured, combined to form a single tube with six free segments. *Stamens* (a) 3 + 3, inserted on the perianth-tube; anthers introrse. *Carpels* three, syncarpous, superior; ovary (*ov*) three-chambered, placenta axile, with a number of ovules in each chamber; style, one; stigma, three-lobed. **Pollination.**—The flower-buds are directed upwards, but they bend downwards as they open. This pendulous position of the flowers serves to protect the pollen. Apparently no honey is excreted; probably long-tongued insects stab the fleshy parts of the perianth and suck the juice. The stamens and carpels ripen simultaneously. **Fruit** a three-valved capsule dehiscing along the dorsal sutures. Seeds numerous, endospermic. **Dissemination.**—After pollination, as the fruit ripens, each flower-stalk once more bends upwards and straightens. The ripe capsules consequently become erect, and the seeds do not drop down immediately round the parent plants (as they would if the capsule were pendulous), but are wafted away by the wind.

OTHER TYPES, USES, ETC. OF LILIACEÆ.

The Asparagus has certain slender green stems and definite green branches, which might be mistaken for leaves. The leaves assume the form of minute pale scales, in whose axils the green branches arise. The edible parts of the Asparagus are the succulent basal shoots which just protrude above the soil. The Asparagus has small flowers, which are frequently diclinous; its fruits are berries. The Lily-of-the-Valley (*Convallaria*) possesses a sympodial rhizome and a raceme of pendulous white flowers, which, in their main features, agree with those of the Hyacinth. Onions and Garlic are cultivated for the sake of their bulbs. The Bluebell, Tulip, Lilies, Fritillaries, Meadow Saffron are familiar plants belonging to this family.

AMARYLLIDACEÆ (Daffodil Family)

The characters are practically the same as those of the Lily-family, except that the flowers are epigynous: $P3 + 3$ $A3 + 3$ $G(\overline{3})$.

In the DAFFODIL (*Narcissus pseudo-narcissus*) (fig. 215) and in the Narcissus we note—(i.) The spathe; (ii.) the petaloid

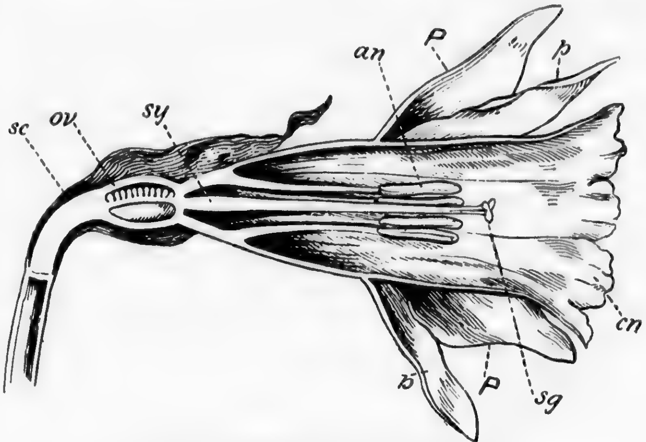

Fig. 215.—Vertical section of flower of Daffodil.

tubular perianth (*P*, *p*), on which is inserted a yellow outgrowth —the corona (*cn*).

In the SNOWDROP (*Galanthus nivalis*), the bulb consists of the swollen bases of the two foliage-leaves of the previous year inserted on a short axis. The plant has only two foliage-leaves each year. The inflorescence-axis bears a spathe and a single pendulous flower. The two whorls of the perianth are composed of separate perianth-leaves; the outer whorl differs in appearance from the inner whorl, so that we may speak definitely of three sepals and three petals. The stamens are not inserted on the perianth, they are epigynous. Each anther opens by two terminal pores. (See also page 32.)

IRIDACEÆ (Crocus Family)

Perennial herbs with rhizomes or corms. Flowers usually regular, cyclic, epigynous, conspicuous. Perianth $3+3$, petaloid. Stamens three, with extrorse anthers. Carpels three, syncarpous; ovary three-chambered, with many ovules on axile placentæ; stigmas three. Fruit a capsule.

Type I.: YELLOW FLAG (*Iris pseudacorus*).*

Vegetative characters.—A perennial herb with a creeping sympodial rhizome. The leaves are mostly radical, sword-like, and overlap in an *equitant* manner. **Inflorescence.**—The main type of branching is cymose. **Flower** (figs. 216, 217) actinomorphic, ☿, cyclic, epigynous. *Perianth* 3 + 3, united to form a long tube, petaloid, yellow. The free parts of the three perianth-leaves, which represent the outer whorl (*P*), are bent downwards, and each has a narrow band of hairs along its middle line. The free portions of the inner perianth-leaves (*p*) are smaller and incline upwards. *Stamens* (*a*) 3 + 0, inserted on the perianth opposite to the outer whorl of perianth-leaves; anthers extrorse. *Carpels* three, syncarpous, inferior; the ovary (*ov*) three-chambered, with many ovules on an axile placenta. The style (*sy*) is single below, but above it divides into three broad flattened petaloid branches, which are opposite to, and arch over, the three stamens (see also fig. 218). On the surface of each band-like branch of the style there is a small thin shelf (*sg*), whose upper face is the stigma. The three chambers of the ovary and the three branches of the style are opposite to the three stamens. This fact convinces us that the three carpels do not alternate with the three stamens. Why are the carpels thus opposite to, or superposed on, the stamens? If we look at a floral-diagram of a Liliaceous plant, and compare it with that of the Yellow Flag, we note that the

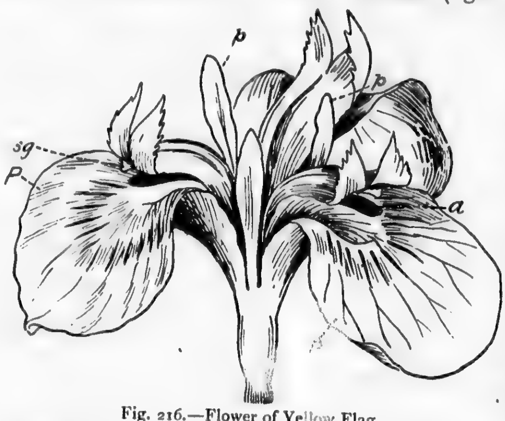

Fig. 216.—Flower of Yellow Flag.

* The flowers of other species of *Iris* grown in gardens are sufficiently like the one here described, to be examined in place of the latter.

two are alike, except that the inner whorl of stamens is missing from the latter. If we now add these three missing stamens to the Iris-diagram, all the successive whorls of the flower alternate in the usual manner. We therefore suppose that in the Yellow Flag (and other Iridaceæ) the inner whorl of stamens is suppressed; and, consequently, in a floral diagram (fig. 219) we put dots to represent the missing whorl, and write down the andrœcium as 3 + 0 (not as three). **Fruit** (fig. 122) a capsule splitting along the dorsal sutures. The numerous flat endospermic **seeds** are dispersed by the wind.

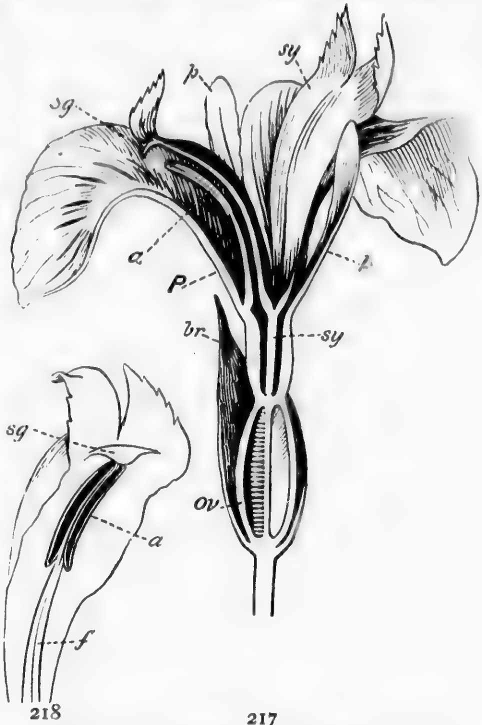

Fig. 217.—Vertical section of flower of Yellow Flag.
Fig. 218.—Stamen with the overhanging arm of style and stigma (*sg*) of ditto.

Pollination. — [In order to understand the method of pollination, a careful examination of the flowers themselves is absolutely essential.] The honey is excreted by the inner face of the base of the perianth-tube, and collects round the base of the style. If an insect is to obtain honey, it must therefore be able, in some way, to reach down nearly to the bottom of the long perianth-tube. Consequently, only insects with long tongues can sip the honey. The Yellow Flag has two varieties of flowers. The one variety is especially

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suited for pollination by humble-bees; and has the three branches of its style quite a noticeable distance above the free parts of the three outer perianth-leaves, so that a humble-bee can creep under the arms of the style. The other variety of flower is adapted to a long-tongued hover-fly (*Rhingia rostrata*); and its style-arms stand so close above the outer perianth-segments that a humble-bee cannot crawl under them. Either insect visiting the flower suited to it alights on the reflexed portions of the outer perianth-leaves; and as it crawls under one of the arms of the style, it touches with its back, first the stigma, and secondly an anther. It then pushes its tongue down the perianth-tube, sucks the honey, and finally backs out of the flower. The stigma is not touched by the retreating insect, because it is situated on the upper face of the ledge which is pushed upwards and backwards as the insect withdraws. In this manner cross-pollination is ensured and self-pollination averted. The flowers of the Yellow Flag again illustrate the principle that the shapes of insect-pollinated flowers are to be associated with the kinds of insects which pollinate them. Flowers of different shapes are adapted to different circles of insect-visitors. The Yellow Flag, in particular, has both "Bee-flowers" and "Rhingia-flowers."

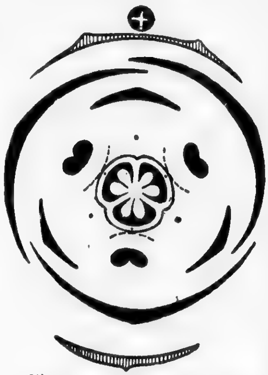

Fig. 219.—Floral diagram of *Iris*.

Type II.: CROCUS (*Crocus*).

The underground shoot is a corm (figs. 49-52). [Dig up Crocuses at different seasons of the year, and observe the method of development of the new corms on the old ones.] The leaves are not equitant. The flowers are constructed on the same general plan as those of the Yellow Flag: $P3+3$ $A3+0$ $G(\overline{3})$. The flower-stalk is short, whereas the perianth-tube is extremely long. The branches of the style are not so conspicuous as those of the Yellow Flag: they are band-like, but are coiled to form tubes.

ORCHIDACEÆ (Orchid Family)

Perennial herbs. Flowers very irregular, epigynous. Perianth 3 + 3, petaloid. Usually only one fertile stamen present; gynandrous. Carpels three, syncarpous; ovary one-chambered, with three parietal placentæ bearing many ovules. Fruit a capsule containing innumerable minute seeds.

TYPE: EARLY ORCHIS (*Orchis mascula*).

Vegetative characters.—A perennial herb with oval subterranean tubers. There are two tubers visible: one is darker in tint, softer, and terminates above in the flowering axis. It is the older tuber at the apex of which there originally occurred a bud which has now developed into the flowering axis. At the base of the latter are inserted spirally-arranged leaves with sheathing bases: the lowest of the leaves are mere sheathing scales. The second tuber, originally developed in the axil of the lowest scale, is lighter in colour and firmer in texture than the mother-tuber. When the inflorescence-axis decays, the older tuber shrivels up, and in the following year the younger tuber will in turn produce another stem bearing foliage-leaves and flowers, as well as an axillary tuber destined to flower in the third year. Each tuber thus lives for two vegetative seasons only. Although a tuber arises as an axillary bud on its predecessor, it is not wholly constituted of shoot: its basal portion is made up of several fleshy adventitious roots which are closely combined. An Orchid-tuber, therefore, consists of root and shoot. The foliage-leaves are parallel-veined and often spotted. **Inflorescence**: a spike with small bracts. **Flower** (figs. 220, 221, 222) median-zygomorphic, ☿, two-lipped, epigynous: colour varying from pinkish-purple to white. *Perianth* (*P*, *p*, *p. l*) 3 + 3. The six perianth-leaves are combined only at their bases. The free portions of five of them [three outer (*P*) and two inner (*p*)] form an upper lip, whilst the sixth (a median inner one) forms a lower lip—the *labellum* (*p. l*). The labellum has a long spur (*sp*). *Stamens* and *carpels*.—The centre of the flower is occupied by a short, thick mass—the *column*—which is formed by the cohesion of the filaments with the style. The column is inserted directly upon the inferior ovary. Looking at the centre

of the flower we see, immediately over the entrance to the spur and attached to the column, two lateral stigma-lobes (*sg*), and just above these a median beaked structure—the *rostellum* (*r*)—which is supposed to represent a third stigma-lobe, though it is incapable of acting as a receptive stigma. Above and behind the rostellum is a single median stamen, consisting of two lobes (*a*) separated by a somewhat broad connective (*co*). In addition to this fertile stamen there occur two lateral stamens without anthers—staminodes (*st*)—attached as appendages to the column, behind the two lateral stigma-lobes. The single anther stands erect, and dehisces towards the rostellum. Each anther-lobe is one-chambered, and contains many pollen-grains adhering together to form a pear-shaped mass—the *pollinium* (*po*, fig. 223)—which possesses a short stalk—the *caudicle* (*c*). The rostellum is shaped like a little bowl (*b*), and contains a gummy mass. The caudicles are attached by their bases to two small balls (*d*) of this gummy substance. The *ovary* is one-chambered, with many ovules (forming after pollination) on three parietal placentæ. **Pollination.**—There is no free honey in the flower; insects pierce the internal lining of the spur and suck the juice from the wound. The flower is visited by bees and flies. The labellum acts as a platform on which the insect alights. A bee pushing its tongue into the spur must of necessity touch the rostellum; the consequence is that one or both pollinia are transferred to its head, where they adhere by means of the adhesive bases of their caudicles. At first the pollinia stand erect on the head of the bee, but they subsequently bend slowly forward, though remaining fixed at their bases. As a result of this movement, the pollinia will inevitably be pushed against the stigma-lobes of a subsequently visited orchid-flower. Did the pollinia remain erect they would, in all probability, be rubbed against the rostellum of a flower visited later: so that no pollination would take place. [The action of the bee in pollinating Orchis-flowers may be imitated by thrusting a sharp-pointed lead pencil into the entrance of the spur; the separation of the pollinia and their subsequent movements will then also be seen.] **True morphology of the flower.**—Hitherto no reference has been made to a peculiarity in the Orchis-flower. The wall of its inferior ovary in its growth causes the flower to execute half a revolution — in fact,

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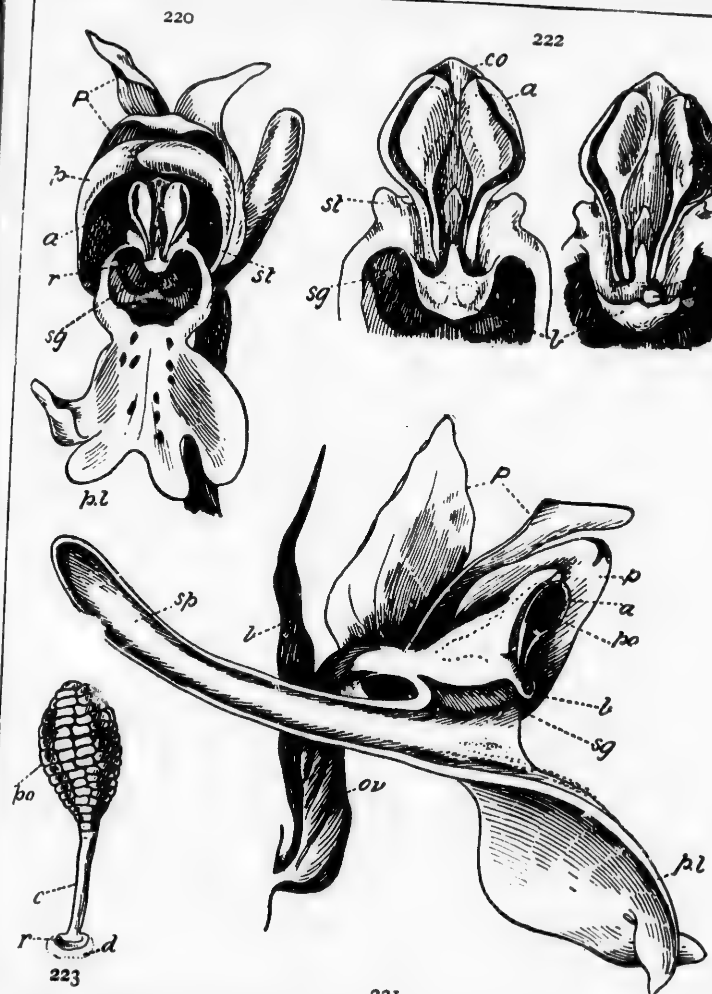

Figs. 220-223.—*Orchis mascula.* Fig. 220.—Front view of flower. Fig. 221.—Median vertical section of flower above the ovary, and an external view of ovary and bract. Fig. 222.—Front view of the stamens and stigmas: left-hand figure, before removal of one pollinium; right-hand figure, after removal of one pollinium, also showing the ruptured rostellum. Fig. 223.—One pollinium and caudicle. (In fig. 221, unfortunately, the letter *b* is used to denote the bract, as well as the bowl-like part of the rostellum.)

to twist so that the true anterior part of the flower occupies a posterior position. Thus the labellum is in reality a median posterior perianth-leaf, and all the other floral-leaves have their true positions reversed in the same manner. The flower consists thus of six perianth-leaves, the median posterior being the labellum; three gynandrous stamens, only one (median anterior) of which is complete; a gynæcium composed of three carpels, syncarpous, with three stigma-lobes, the anterior median lobe of which no longer functions as a stigma, but is the rostellum (see fig. 224 for further details). The floral formula is $P3+3$ $A1+2$ $G(\overline{3})$. **Fruit** (fig. 225) a capsule dehiscing along the dorsal sutures, and allowing the innumerable minute **seeds** to be dispersed by the wind.

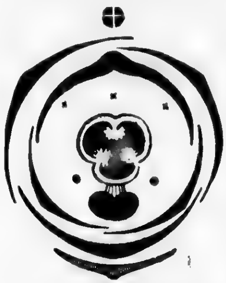

Fig. 224.—Floral diagram of *Orchis.*

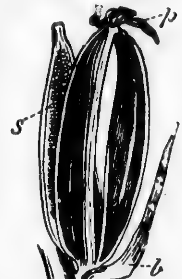

Fig. 225.—Fruit of *Orchis mascula*: *b* = subtending bract; *s* = seeds.

[In place of *Orchis mascula,* other British species of *Orchis* may be selected for examination, and the various points described above will be easily seen.]

ARACEÆ (Arum Family)

Smooth herbs with leaves which are often broad and net-veined. Inflorescence a spadix with a spathe; no bracts subtending the separate flowers; no prophylls in the inflorescence. Flowers small, inconspicuous. Perianth small or absent. Fruit, a berry.

TYPE: THE CUCKOO PINT (*Arum maculatum*).

Vegetative characters.—Herb with a corm. The leaves are radical, each possessing a basal sheath, a petiole, and a net-veined spotted lamina shaped almost like an arrow-head. **Inflorescence** (fig. 226).—A large sheathing bract—the *spathe*

—encloses the part of the flowering axis which bears the flowers. The flowering axis above the point of insertion of the spathe bears—(i.) At its base, a zone of many sessile ovaries (*ov*); (ii.) higher up, an encircling band of incomplete or rudimentary ovaries (*sf*); (iii.) still higher, a belt of numerous sessile anthers (*a*); (iv.) above these again, a zone of hairy structures (*sf′*), the hairs of which span the space between the floral axis and the narrowed portion of the spathe-sheath. Finally, the purple-tinted terminal part of the axis (*sx*) is thickened, but devoid of any lateral structures. This axis, with its stamens and ovaries, does not represent a single flower, for the ovaries are inserted below the stamens on the convex axis. It is an inflorescence consisting of many carpellary and staminate flowers borne on a fleshy axis. This view is shown to be correct by the circumstance that in some other Araceæ each of the numerous little flowers of the spadix possesses a small perianth of its own. The **carpellary flower** (fig. 228) consists solely of one single carpel. The ovary (*ov*) is one-chambered, and contains several ovules (*o*) attached to its wall. The stigma (*sg*) is sessile. Above these fertile

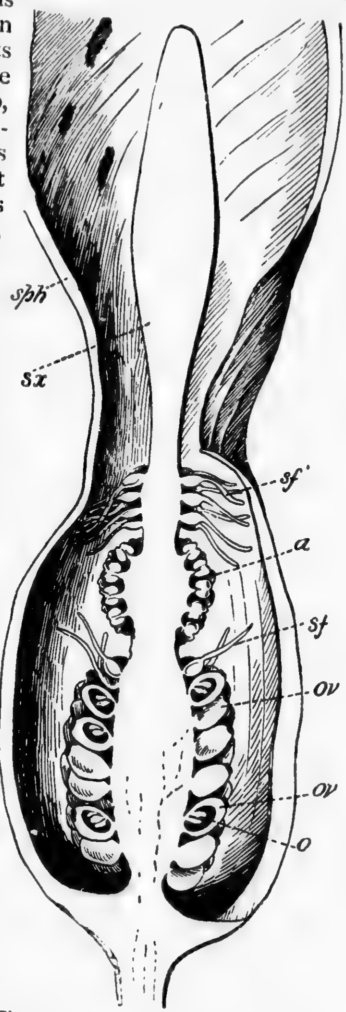

Fig. 226.—Vertical section of spadix and part of spathe of *Arum maculatum*.

carpellary flowers are a number of **sterile carpellary flowers** (*sf*) without ovules. The **staminate flower** consists of a small group of three or four stamens (or at the very base of the staminate region each flower may have only one or two stamens). The anthers are sessile (fig. 227). Above the staminate flowers the band of hairy structures represents a belt of **sterile flowers** (*sf'*). **Fruit.**—After pollination each ovary gives rise to a single red berry (fig. 229). Thus the carpellary inflorescence produces a cluster of berries (fig. 230), which is an infructescence, because it is formed by several flowers, and not by one. **Pollination.**—In spite of their inconspicuousness, the flowers are insect-pollinated; the inflorescence emits a peculiar odour, and the purple tip of the spadix aids in alluring the small flies which effect cross-pollination. The whole inflorescence forms a trap to catch these minute flies, which creep down the spathe into the chamber formed by the tube of the latter. The ovaries mature before the stamens, and at this stage of flowering the palisade of hairs spanning the mouth of the spathe-tube does not prevent the entrance of the midges, though it hinders their departure. If the flies have come from another spathe, they bear pollen and pollinate the stigmas of the ovaries which are now ready. After a

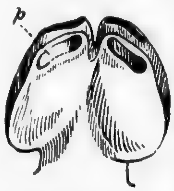

Fig. 227.—A stamen of *Arum maculatum*.

Fig. 228.—Carpellary flower of *Arum maculatum*.

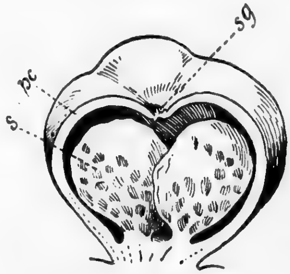

Fig. 229.—A berry of *Arum maculatum* cut open.

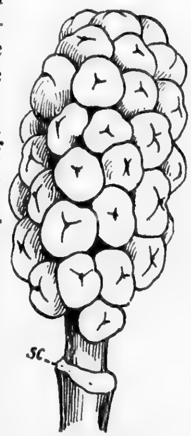

Fig. 230.—Infructescence of *Arum maculatum*.

time, the stigmas wither and secrete honey which is sipped by the imprisoned midges. Only then do the anthers ripen and pour out their pollen, with which the captive-insects become sprinkled. Finally the bars of the prison are loosed, for the hairs forming the palisade wither and allow the flies to escape dusted with pollen. The whole inflorescence is therefore specially constructed so as to accomplish the cross-pollination of the flowers by the agency of small flies.

GRAMINACEÆ (Grass Family)

Herbs. Stems cylindrical, hollow except at the nodes. Leaves alternate, ligulate, with sheaths usually split down to the base. Flowers ranged in spikelets with chaffy bracts. Flowers regular, inconspicuous, hypogynous. Perianth absent (or perhaps represented by two minute scales). Stamens usually three, with dangling anthers; ovary one-chambered, with one ovule; stigmas usually two, feathery or brush-like.

TYPES: WHEAT, COUCH-GRASS, MEADOW-GRASSES, FOXTAIL, COCKSFOOT.

Our British Grasses are *herbs* with cylindrical stems which are hollow except at the nodes.

The *leaves* are alternate, and ranged in two rows along the stem. They are long, narrow, parallel-veined, and usually have prominent ribs. The base of the leaf surrounds the stem in the form of a sheath which is, in most cases, split down one side. At their regions of insertion the sheaths are thickened, and thus cause the nodes to appear swollen. Each leaf has a *ligule* (see page 15). In the bud the leaves are often rolled; but the Meadow-Grass and Cocksfoot have their young leaves folded.

Branches which bear foliage-leaves arise only in the axils of radical leaves. In some Grasses these axillary branches burst through the enveloping sheaths, and, running horizontally underground for some distance, lead to the formation of sympodial rhizomes with scale-leaves, as described on page 25. On the other hand, the branches which arise in the axils of the radical leaves may at once ascend, after either bursting through the surrounding sheaths or pushing their way between

the latter and the stem. Even in one and the same Grass-plant both horizontal and ascending branches may occur together. It is the method of branching, together with the direction of growth of the lateral shoots, which determines whether the particular Grass will form a simple tuft, a series of tufts, or a mat-like layer.

Fig. 231.—Inflorescence of Wheat.

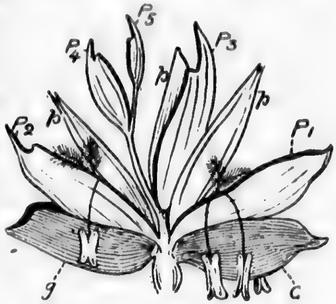

Fig. 232.—A spikelet of Wheat.

Some Grasses are annual (*e.g.* Wheat), others are perennial (*e.g.* Couch-Grass). Some annual Grasses, when sown in autumn, become biennial in that they rest during the winter and do not flower until the following spring.

Inflorescence.—The flowers are arranged in small spikes which are termed *spikelets.* A head of wheat (fig. 231), for instance, at first sight looks like a spike with two rows of sessile flowers: whereas, in reality, it is a spike of spikelets. A spikelet (figs. 232, 233) consists of a stem bearing a few alternating bracts arranged in two rows, and a small number of sessile flowers with prophylls. The lowest two bracts (G, g) on the spikelet axis are termed *glumes*; one of them, the *lower glume* (G), is inserted nearly opposite to, but at a slightly lower level than, the other, which is the *upper glume* (g). These two glumes have

Fig. 233.—A scheme of a spikelet of a Grass.

no flowers in their axils; they constitute, in fact, a small involucre. Above them, on the spikelet axis, are bracts which form two rows, have single flowers in their axils, and are termed *flowering glumes* or *lower pales* or *paleæ* (P_1, P_2, P_3, P_4, P_5). These latter alternate as do the glumes, so that the first or lowest of them (P_1) stands above the lower glume (G): the second (P_2) is inserted on the opposite side of the axis and is above the upper glume (g). The flowering glumes, and less frequently the barren glumes, may have their mid-ribs continued into a tail-like "awn."

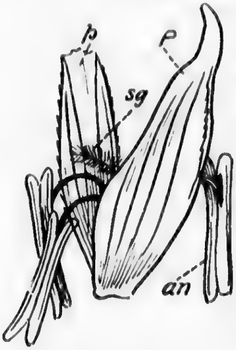

Fig. 234.—A flower of Wheat enclosed in its two paleæ.

Fig. 235.—Diagram of flower of Wheat.

There are from three to five flowering glumes and flowers in a spikelet of the wheat. The *flower-stalk* is scarcely perceptible, but, as is usual amongst Monocotyledons, it bears a single *prophyll* (p) which is typically on the face (posterior) towards the inflorescence-axis. This prophyll is scale-like, and is termed the *upper pale* or *upper palea*. Each flower (fig. 234) lies partially hidden between its prophyll (the upper pale) and its subtending bract (the flowering glume). It is important to note that each flowering glume is on the axis of the spikelet, and is usually one-ribbed:

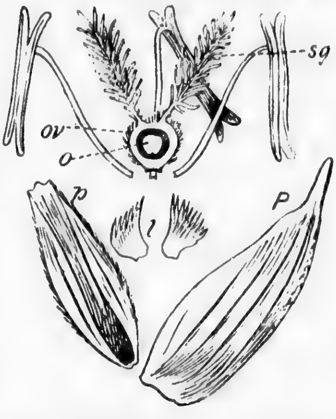

Fig. 236.—Dissected parts of flower of Wheat with the lodicules, and two investing paleæ. The ovary (ov) is cut vertically, and shows one ovule (o).

whereas the upper pale is on the almost imperceptible flower-stalk, and is often two-ribbed. In many Grasses, on each flower-stalk, higher up than the upper pale, are inserted two minute scales—the *lodicules* (figs. 233, 236 *l*). Some botanists regard these latter as representing a simple perianth; others are of opinion that they represent a small divided bract, in which case they are not a portion of the flower proper. The **Flower** consists of three (rarely two) stamens inserted below the ovary, and possessing dangling anthers; together with a one-chambered ovary containing one parietal ovule, and surmounted by two brush-like or feathery stigmas. It is usually supposed that the gynæcium represents one carpel, the style of which has branched. If this view be correct, it must be described as being apocarpous.

Different types of Grasses.—The spikelets may be arranged in panicles or in spikes. In each spikelet there may be one or more flowers. The lodicules may be present or absent. The accompanying table (see opposite) illustrates the general details in some common types of Grasses. (In all these the gynæcium is the same throughout as regards its general constitution.)

Pollination of Grasses.—In some grasses (*e.g. Poa* and others) the upper and lower paleæ enveloping a flower separate considerably; the anthers emerge and dehisce quickly, and the stigmas separate. It is the lodicules which cause the opening; they swell and force back the lower paleæ. After a time the lodicules shrivel up, and consequently the paleæ close. In other grasses the paleæ scarcely open, and the stigmas are brush-like (not feathery). As the lodicules are not called upon to force the paleæ apart, they are absent (*e.g.* Timothy-grass) or very minute (*e.g.* Foxtail-grass). The grasses are cross-pollinated by the agency of the wind; the long filaments, with their dangling anthers, are easily shaken by even light breezes, and the large brush-like or feathery stigmas display a large surface to receive the wafted pollen. Many grasses are regularly self-pollinated (*e.g.* Wheat, Barley, Oats).

Fruit.—After fertilisation the one-ovuled ovary gives place to a dry one-seeded indehiscent fruit very like an achene; but the seed is so closely adherent to the pericarp (original wall of the ovary), and the testa so thin, that it is impossible to distinguish the testa and pericarp without the aid of a

compound microscope, or, more frequently, the testa is completely destroyed before the fruit is ripe. This fruit is distinguished under the name of *caryopsis*. A grain of wheat (fig. 28), or a so-called grass-seed, is in reality a fruit, because the ovary takes part in its formation. Often the paleæ persist and continue to envelop the ripe fruit. Usually the fruit is grooved along one side (ventral side). **Seed.**—This has already been described (page 19); it is endospermic, with an embryo of peculiar structure.

	On the main Inflorescence axis.	On the axis of the Spikelet.		On the axis of the Flower (gynæcium omitted).		
NAME AND VEGETATIVE CHARACTERS.	Arrangement of the Spikelets.	Glumes.	Flowering Glumes (lower paleæ).	Upper Paleæ.	Lodicules.	Stamens.
Sweet-scented Vernal Grass (*Anthoxanthum odoratum*). A tufted grass; perennial.	Spike-like panicle.	4	1	1	0	2
Meadow Foxtail (*Alopecurus pratensis*). With long scale-bearing rhizomes; perennial.	Spike-like panicle.	2	1	0	2 minute.	3
Wheat (*Triticum vulgare*). Annual.	Spike.	2	3-5	1	2	3
Couch-grass (*Agropyrum repens*). Perennial, with elongated scaly rhizomes.	Spike.	2	3-9	1	2	3
Annual Meadow Grass (*Poa annua*). Tufted annual.	Panicle.	2	3-7	1	2	3
Smooth Meadow Grass (*Poa pratensis*).	Panicle.	2	3-5	1	2	3

PART III

PHYSIOLOGY

CHAPTER XV

THE NUTRITION OF THE PLANT

1. **A Plant absorbs** (feeds itself).—If healthy seeds be sown under suitable conditions, they germinate, and finally give rise to plants much larger than themselves. A small acorn develops into a huge oak-tree : a tiny turnip-seed produces a large turnip-plant. The plants obviously weigh more than the seeds from which they have developed, and they must therefore contain more matter or substance than was originally possessed by the seeds. This substance gained by the plant during its growth has not been created out of nothing; it must have been derived from matter previously present outside the plant. Thus it is certain that the plant takes in, or absorbs, substance from the outside world—that is, takes food from the soil or from the atmosphere, or from both.

2. **What does a Plant absorb?** A seed, or a whole plant, is composed of solid substance and water; in addition it contains gases, which we will not discuss for the present. If we dry a seed, or a plant, at a temperature slightly higher than the boiling-point of water (100° Centigrade), the water will be driven off in the form of steam, and only solid substance will remain. An ordinary seed, though it appears to be quite dry, contains at least one-tenth of its whole weight of water, whilst there is still more water in growing plants; for instance, nine-tenths of the weight of a turnip - plant is due to the water. If we weigh separately a plant and one of its seeds, both before and after drying them, we find that there is more water and more solid substance in the plant than in the seed. We thus see that as a plant grows it absorbs not only water but also other substances.

3. **Chemical Composition of a Plant.**—In order to learn what substances, in addition to water, are taken into the plant, we must find out what simple chemical substances (*elements*) are present in the plant. If we still further heat a completely dried seed or plant there will be an additional loss in its weight, because some of the substances composing the plant

are decomposed, and some combine with the oxygen in the air, and pass off in the form of gases (carbonic acid, ammonia, water, etc.). There remains behind only a little mass of solid called the *ash*. Examining the gases which pass off and the ash which remains, we learn that the following elements are always present in plants:—**Carbon** (C), **Hydrogen** (H), **Oxygen** (O), **Nitrogen** (N), **Sulphur** (S), **Phosphorus** (P), **Potassium** (K), **Magnesium** (Mg), **Calcium** (Ca), **Iron** (Fe). [Sodium (Na), and Chlorine (Cl).] Occasionally other elements also occur. These elements are combined to form the various chemical compounds of which the plant is composed. The grown-up plant contains a larger quantity of each of these elements than did the seed from which it developed. The growing plant, therefore, must have absorbed these elements from the soil or from the atmosphere.

4. **Composition of the Air and of the Soil.**—The atmospheric *air* consists mainly of free nitrogen (N)* and free oxygen (O), very little carbonic acid (CO_2), traces of ammonia, (NH_3), and water vapour (H_2O).

The *soil* is mainly made up of small particles or grains, amongst which there are little spaces occupied by air and water. The grains of soil contain salts which are soluble in water: thus the water in the soil is not pure, it is a solution of certain salts. These soluble salts contain all the elements required by the plant. In addition, the soil contains the decaying remains of dead plants and animals, or *humus*. The accompanying table shows which are the commonest inorganic salts dissolved in the water of the soil. We particularly note the absence of carbon from this list—

NAME.	SYMBOL.	ELEMENTS PRESENT.
Common table salt	$NaCl$	Sodium and chlorine.
Gypsum	$CaSO_4$	Calcium, sulphur, and oxygen.
Glauber's salts	$NaSO_4$	Sodium, ,, ,,
Epsom salts	$MgSO_4$	Magnesium, ,, ,,
Traces of chlorides, nitrates, and phosphates of calcium, magnesium, and potassium		Chlorine, nitrogen, oxygen, phosphorus, calcium, magnesium, and potassium.

* The element *Argon* is included under the head of Nitrogen, because we do not know its relation to plant life.

5. **Cultivation of Plants in Artificial Soils or Solutions.**—The soil contains all the chemical elements required by a plant, but the atmospheric air contains only four* elements (N, O, C, H). Those chemical elements present only in the soil are obviously absorbed from that source. But with regard to the four elements present in the soil as well as in the air, experiment alone can decide whence the plant obtains them. In order to decide this question, and to ascertain which elements are absolutely essential to the existence of plants, we cultivate plants with their roots dipping in water containing only certain definite salts dissolved in it (fig. 237); or we may make a simple artificial soil by pouring this nutritive solution on pure insoluble sand.

Fig. 237.—A grass-plant grown with the aid of a culture-solution.

A good nutritive solution (termed a "culture solution") can be made up as follows:—

	Metric System.	English Measure.
Water - - -	1000 cub. centimetres.	5 pints (100 ounces).
Potassic nitrate -	1 gramme.	45 grains.
Calcic sulphate -	½ ,,	25 ,,
Magnesic sulphate -	½ ,,	25 ,,
Calcic phosphate -	½ ,,	25 ,,
†Sodic chloride -	½ ,,	25 ,,
Sulphate of iron -	A trace.	Trace.

* Five with Argon. Occasionally, too, the air has impurities such as common salt.

† The sodic chloride is not absolutely necessary, but serves to keep the plant healthy.

A seed provided with this nutritive solution, under suitable conditions (see after), can produce a seedling, which in turn may develop into a plant with flowers and fruit. The plant therefore has every chemical element it requires.

6. **A green plant can manufacture complex organic (carbon-) compounds from simple inorganic food.**—The solid matter of a seed, or of the plant derived from it, consists mainly of organic compounds—that is, it consists chiefly of compounds of carbon which readily combine with oxygen. Comparing the seed and the plant, apart from the great increase in the amount of water in the plant, the most marked difference in the composition of the two is the immense addition to the quantity of the organic carbon compounds. Cultivated with the "culture-solution" described, the plant has only inorganic food at its command; in particular, its carbon-containing food is available only in the form of the carbonic acid (CO_2) present in the air. Animals cannot build up organic compounds from simple inorganic food; this power is confined to plants.

CHAPTER XVI

ABSORPTION OF CARBONIC ACID BY THE GREEN PLANT

If a few green leaves, or a green branch, be placed in a closed, moistened, air-tight bottle and exposed to the light, the carbonic acid contained in the air within the bottle will disappear and an equal volume of oxygen will replace it. This shows that *green leaves, or green parts of a plant, can obtain carbon from the carbonic acid of the air.* If, however, the bottle and the contained leaves be placed in darkness, the carbonic acid will not disappear. This experiment illustrates the fact that *light is required in order to enable the green parts of plants to obtain carbon from carbonic acid.* Again, if the leaves be killed (by steaming, freezing, drying, or poisoning by chloroform) before they are placed in the bottle, the carbonic acid will not disappear even in the presence of light. This demonstrates that the *green parts must be living if they are to obtain carbon from carbonic acid of the air.* But if, instead of placing green parts of plants in the bottle, we put parts without the green colouring-matter, such as petals, roots, pieces of fungus, the carbonic acid does not vanish. This serves to show that *only parts containing green colouring-matter can obtain carbon from carbonic acid in the atmosphere.*

We have not yet seen how the green parts obtain the carbon from carbonic acid, or how it is that an equal volume of oxygen appears in the atmosphere in place of the carbonic acid. This is most easily shown by experiments on green submerged water-plants. If we cut across the shoot of such a water-plant, and leave it in the water exposed to light a stream of bubbles will arise from the cut end of the stem (fig. 238). These bubbles consist of oxygen which is being exhaled by the plant. No bubbles of oxygen will be given off

in darkness, nor if the plant be killed, nor if the water contains no carbonic acid, nor if the roots which are without green colouring-matter be used instead of the green shoot. Consequently we conclude that the oxygen is given off only from the parts which are receiving carbon from the carbonic acid. In other words, the **living plant exposed to the light takes in carbonic acid by means of its green parts, it retains the carbon as food but gives the oxygen back to the air.**

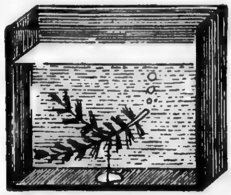

Fig. 238. — Evolution of bubbles of oxygen from the cut end of a stem under water. (Based upon A. Mayer's figure.)

Influence of Temperature on the absorption of carbonic acid and on the evolution of oxygen by green parts. — If the experiments just described are to be successful, the green parts must be exposed to a proper temperature. If the bottle or the water be kept too cold, or too hot, there will be no absorption of carbonic acid, and no evolution of oxygen. There are three important temperatures—(i.) the lowest temperature, or *minimum*, at which the plant can still absorb carbonic acid and exhale oxygen; (ii.) the highest temperature, or *maximum*, at which these processes still go on; (iii.) the best or most suitable temperature, or *optimum*, at which the plant is performing these processes most rapidly. Of course, the optimum temperature lies between the minimum and maximum.

Influence of the intensity of Light on the absorption of carbonic acid and evolution of oxygen by green parts.—Light is essential to the process. Commencing with darkness, as we increase the intensity of the light to which the plant is exposed the two processes become more and more active. This may be illustrated by a simple experiment made on the cut shoot of the water-plants. We note that near the window, exposed to the sun, the bubbles of oxygen come off rapidly, but when the plant (in the water) is transferred to a gloomier part of the room the bubbles appear more slowly, till in absolute darkness they cease entirely.

Chlorophyll, or the green colouring-matter.—The substance which causes the green colour of leaves and stems may be termed chlorophyll. Placing leaves in water, the chlorophyll is not removed from them, for it is insoluble in water.

But an impure solution of chlorophyll may be obtained by extracting the leaves by the aid of methylated spirits. The leaves in time become whitish in colour, and the solution becomes coloured. The solution is green in colour when we look through it; whereas it appears to be blood-red if we inspect it when placed before a dark background. Light decomposes the chlorophyll in the alcohol-solution, also in plucked leaves themselves. This is all the more curious because chlorophyll does not form in flowering plants unless the latter be exposed to the light. A plant grown in darkness has whitish or yellowish leaves. Bringing this bleached plant into the light, the leaves soon assume a green colour; *light is essential* to the formation of chlorophyll.* If the bleached plant be killed before being exposed to the light it will not produce chlorophyll; *the plant must be living* if it is to make chlorophyll. Again, if a germinating seed be supplied with the solution mentioned on page 191, excepting that the iron be omitted, the plant grows for a time, but is yellow. If we now supply the iron, it becomes green. Therefore *iron is required* for the formation of chlorophyll. Finally, a *certain degree of warmth* is essential for the manufacture of chlorophyll. Probably the autumn tints of leaves are partially associated with the decomposition of the chlorophyll under the influence of light and the slowness of the production of new chlorophyll because of the low temperature prevailing.

* There are some exceptions to this rule even among flowering plants; and the rule does not hold good for non-flowering plants.

CHAPTER XVII

ASSIMILATION OF CARBON

In the previous chapter it has been shown that the green parts absorb carbonic acid and return to the air the oxygen contained in the carbonic acid. The green parts, therefore, act as a reducing mechanism,* and it follows that in them some organic compound is formed at the expense of the carbon obtained. For let us remember that our definition of an organic compound is a carbon-containing body which is capable of combining with oxygen. The first step, in following the career of the absorbed carbonic acid, is to ascertain what organic bodies are found in the plants.

First, there is no pure free carbon found in plants, so that the absorbed carbonic acid does not simply lose its orygen, and thus lead to the formation of pure carbon. There are three universally present and important classes of organic compounds found in all flowering plants. They are **Proteids (Albuminoids)**, **Carbohydrates**, and **Fats** or **Fatty Oils**. These show their organic nature in being able to burn—that is, they are able to combine with the oxygen of the air and give off carbonic acid.

I. **Proteids** are very complex compounds of carbon, containing also hydrogen, oxygen, nitrogen, sulphur, and sometimes phosphorus. The white of an egg is a good example of a proteid, and the "lean" of meat is mainly proteid. Proteids stain deeply with many dyes: they assume a yellow or brown colour with iodine. There is one substance which is mainly composed of proteids, and which is the most important part of a plant or animal—in fact, it is the only living part of living beings, and is termed **protoplasm**. Continued growth of a living being (plant or animal) implies an increase in the amount of protoplasm. Hence, if a plant is to continue growing, it

* By a "reducing mechanism" is meant a mechanism which wholly or partially deprives certain oxygen-containing compounds of their oxygen.

will require constant supplies of carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus, all of which are required to build up protoplasm. In addition, protoplasm contains water. In flowering plants the living protoplasm can be studied only by the aid of the compound microscope. It then reveals itself as a colourless, transparent, viscid substance, often with small granules in it: it is capable of growing, dividing, and moving about. All the complex processes performed by plants are due to the action of protoplasm. Therefore, in studying plants without the aid of a compound microscope, we are largely engaged in learning the properties of this living substance—protoplasm.

II. **Carbohydrates** are simpler bodies than proteids; they contain no nitrogen. **Sugars** are carbohydrates which are soluble in water. The sugar used for domestic purposes is *Cane-sugar* ($C_{12}H_{22}O_{11}$), which occurs in many plants (notedly in Sugar-Maples, Beet, Sugar-Cane). *Grape-sugars* ($C_6H_{12}O_6$) also are found in plants. The test for grape-sugar is to warm Fehling's blue solution, which, on the addition of grape-sugar, forms a yellow precipitate. **Starch** ($C_6H_{10}O_5$) is a solid body which is insoluble in water. By the use of dilute acids, or of certain "ferments," starch may be converted into sugar. Starch is easily recognised by its character of becoming blue on the addition of iodine. A drop of iodine placed on the cut surface of a potato-tuber, on ground rice or corn, causes a deep blue spot, thus showing that these bodies contain starch. **Cellulose.**—The solid framework or skeleton of a plant is mainly constituted of cellulose, or bodies allied to cellulose. Cellulose is a solid, colourless substance insoluble in water. When treated with sulphuric acid, it swells up and forms a substance like starch-paste, and then it will turn blue when treated with iodine. More prolonged treatment with the dilute acid causes the cellulose to change into sugar. Unchanged cellulose is stained yellow by iodine. *Wood* and *Cork* may, for the present, be regarded as peculiarly modified celluloses. Thus the familiar carbohydrates are all sugars or substances easily convertible into sugars.

III. **Fats** and **Oils.**—These might be included under one name, as a fatty-oil is merely a liquid fat. They are composed of carbon, hydrogen, and oxygen, but contain no nitrogen.

They are poorer in oxygen than are carbohydrates. They will not dissolve in nor mix with water.

Formation of Starch at the expense of the carbonic acid absorbed by leaves.—If we cultivate a bean-seedling with the aid of the inorganic culture-solution mentioned on page 191, but keep it constantly in absolute darkness, we shall find that the organic substance in the seedling is not greater in quantity than it was in the seed. This is due to the fact that, in the absence of light, the plant cannot absorb carbonic acid. The plant is starving. If we now pluck some of its leaves, put them in methylated spirits to decolorise them, and finally place them in a solution of iodine, the leaves will assume a yellow colour. They contain no starch. If we now expose the plant to the light for several days the leaves become green, and soon absorb carbonic acid; and when we treat these leaves as we did the others, they assume a deep blue colour (appearing black) in iodine. Therefore these green leaves contain starch. In the bean-plant *the absorption of carbonic acid by green leaves exposed to the light causes starch to be manufactured.* If we expose only the roots to the light, starch will not appear in the starved plants: this illustrates the fact that chlorophyll is essential for the formation of starch at the expense of carbonic acid. Again, if we expose the leaves of the starved plant to the light, but remove the carbonic acid from the air surrounding the plant, no starch will appear. This proves that it is the carbonic acid which supplies the carbon essential to build up the starch. The same experiments may be performed on a green bean-plant which has been grown in the presence of light but subse-

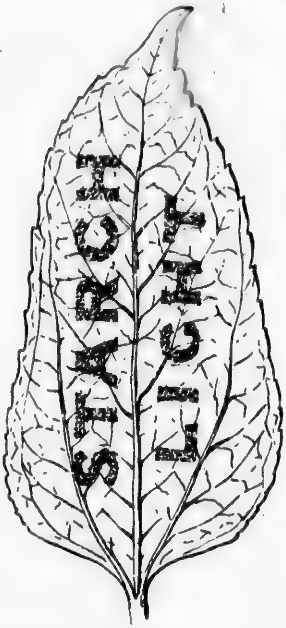

Fig. 239.

quently darkened for some days. A pretty experiment may be made on a single large leaf of a sunflower. The leaf should be encased in tinfoil and kept flat, a pattern then cut out from the upper face of the tinfoil. For instance, the words "starch" and "light" in capital letters may be cut out. The leaf must be left for some days (still attached to the plant). It is then removed and tested for starch, and it will be found that, after treatment with methylated spirits and subsequently with iodine, the pattern will be marked in dark blue, whereas the rest of the leaf will be yellow in colour. Only those parts of the leaf which have been exposed to the light have manufactured starch (fig. 239). If we use a plant with variegated leaves which have patches of white, after darkening the leaves for several days, and then exposing them to the sunlight for one day, we find that starch is present only in the green parts of the leaf. This again illustrates the fact that only the green parts absorb carbonic acid and build up starch by its aid. If we kill the leaves they will not manufacture starch.

How does the carbonic acid get inside the leaves? If we fit a leaf into an air-tight india-rubber stopper, and place it in connection with the apparatus as given in figure 240, and we then suck at the tube, the suction drains away the air from above the water in the bottle, and we see bubbles of air coming from the cut end of the leaf-stalk to the surface of the water. We can continue this experiment for a considerable time, thus proving that the air which bubbles from the leaf-stalk is not simply air which was inside the leaf; but that it has come from the atmosphere outside the bottle, passing in by the lamina, and travelling down the leaf-stalk. The leaves of the majority of ordinary plants absorb carbonic acid by their lower surfaces, and only slightly or not at all by their upper faces. Hence a leaf coated with vaseline over its whole surface, or over only its lower face, does not manufacture starch at the expense of carbonic acid. But if only the upper surface of the leaf be painted with vaseline, the carbonic acid can enter by the lower face of the leaf, and starch will appear.

Fig. 240.

Green parts which do not produce starch.—Some plants produce little or no starch in their green leaves. The onion, for instance, produces sugar. Some other plants produce oils at the expense of the carbonic acid.

Why is Light essential to the production of organic matter at the expense of Carbonic Acid?—If we apply a light to organic material (say wood) we know that it will burn. We make the burning wood (or leaves or coal) do work by setting it to drive an engine. The work is done because heat is given out by the combination of oxygen with the organic material. The oxygen and organic material combine and produce compounds including water, carbonic acid, and ammonia. Now, if we want to make these latter substances once more form organic substance, we must remove the oxygen with which their carbon is combined. In order to remove the oxygen it is necessary to restore the heat (or its equivalent) which was given away when the organic matter combined with the oxygen. In other words, to tear the oxygen of carbonic acid apart from the carbon, force must be applied; and this force (or, more properly, energy) is supplied to the leaves in the form of sunlight. The *green part of a plant is a machine for collecting and holding sunlight, by the aid of which to force apart the oxygen and carbon of carbonic acid, with the object of building up organic matter* (starch, sugar, fats, etc.). Put into rough words, a leaf is a "trap to catch a sunbeam."

The transport of Carbohydrates in a Plant.—Starch and sugar are not only found in the green parts of plants, but they also occur in parts which have not been exposed to light and which do not contain chlorophyll. For instance, the subterranean tubers of the Potato contain much starch; the fleshy roots of the Beet and *Dahlia* are rich in sugars. Starch and sugar can appear in these underground parts even when the plant has obtained its carbon solely from carbonic acid. Yet we have learned that if plants be compelled to obtain their carbon from carbonic acid, starch and sugar are formed only in the green parts exposed to light. This proves to us that the starch or sugar in the roots or tubers must have been derived from the organic material manufactured in the green parts; it is therefore evident that organic material can travel inside the plant. This is easily shown by simple experiments on leaves which manufacture starch. If we pluck some leaves

which we know to be rich in starch, and keep them for one or two days in a moist, dark place, we shall find that the starch will disappear, but an equivalent amount of sugar will appear. The insoluble solid starch has changed into soluble sugar. If we perform this experiment on a leaf still attached to the plant, the starch will disappear, but an equivalent amount of sugar will not be present in the darkened leaves. In this case the starch has changed into sugar, but the sugar has travelled away into the stem. In other words, *carbohydrates travel through the plant in the form of sugar.* In the potato-plant, when the sugar reaches the tubers it changes once more into starch; whereas, in the case of the beetroot, the sugar is deposited as sugar in the root.

Starch, Sugar, and Fats are food-substances.—We at once ask of what use to a plant are starch, sugar, and fats which have been manufactured by the leaves? The question is easily answered by reference to observations on seeds and plants grown from them. We find that in a bean-embryo in the seed there is much starch, and some proteid, as well as a little cellulose. If we germinate this seed in darkness with the aid of an inorganic culture-solution (page 191), when the seedling stops growing we shall find that it contains little or no starch, but has relatively more cellulose, sugar, and proteids, than was possessed by the embryo inside the seed. This proves that the starch has been used up in the manufacture of the cellulose framework and in building up new protoplasm. In fact, the starch in the seed is changed to sugar and travels to the growing parts of the shoot and root, and there acts as food to the developing organs. Similar observations can be made on potato-tubers which contain starch. Again, if the seed contains much fat (or oil), as is the case with the castor-oil seed, it is the oil which disappears and aids in the construction of new plant-substance. All the chemical processes involved in the building up of protoplasm from simpler substances are described under the name of *assimilation.* In the process of assimilation of carbon, the earliest easily detectable products in green parts are sugar, starch, or oil. These substances may be consumed at once in the manufacture of new protoplasm and new plant-substance; or they may be transported to some distant part of the plant and deposited there for future consumption. In the latter case they are

described as *reserve-substances*. The proteids, starch, and oil stored up in seeds are reserve-foods, to be used later on by the developing seedling. Swollen subterranean stems and roots are storehouses of starch (*e.g.* Potato), or sugar (*e.g.* Beet), etc., which will feed the sprouting shoot in the following year.

Nutrition of Plants possessing no chlorophyll.—Some plants, such as Fungi and the Dodder, are devoid of chlorophyll. Consequently they are incapable of obtaining their carbon from carbon dioxide: they require supplies of organic carbon-compounds. Some of these plants absorb their organic food from other living plants, upon which they prey. They are then described as **parasites** (*e.g.* Dodder, Broom-rape). Other plants which possess no green colouring-matter obtain the needful carbon-compounds from the dead remains and products of plants and animals; these are described as **saprophytes** (*e.g.* Bird's Nest Orchid, *Monotropa*). It must be noted, however, that some parasites, such as the Mistletoe, and some saprophytes, have green leaves.

CHAPTER XVIII

ABSORPTION OF WATER AND INORGANIC SALTS

Plants take in and give out water.—If flowering plants be not supplied with water, they not only cease growing, but they droop, wither, and finally die. This familiar fact demonstrates that the plants both absorb and give off water.

The roots are the water-absorbing organs.—If we supply water to the leaves and stems of an ordinary flowering-plant, but keep the soil dry, the plants wither. This proves that the shoot is not able to absorb sufficient water. It is easy to show that roots absorb water; we merely have to watch the diminution of the water from culture-solutions in which the roots are growing. By the aid of the simple apparatus given in fig. 241 it is possible to measure exactly the rate at which the roots are sucking water in.

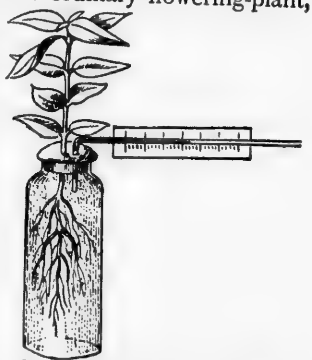

Fig. 241.—A thin, bent glass-tube filled with water, and a plant, are fixed, as figured, by means of an air-tight cork, into a bottle full of water. As the root absorbs, the rate at which the water is sucked along the tube is noted by the aid of a graduated piece of cardboard.

The roots also absorb salts dissolved in water.—This statement is easily proved by observing that the salts in culture-solutions decrease in amount as the roots absorb water.

Salts can be taken in by a root only when they are dissolved in water.—It is not easy to prove this statement without the use of the compound microscope; but three experiments illustrate the truth. If, instead of growing seedlings with the help of a culture-solution, we give them water to which have been added insoluble salts of all the chemical elements required

by the plant: we shall note that the root will absorb the water but the salts remain as a powder in the vessel, and soon the plants cease to grow. If we get some powdered eosin, and add it to the water, the eosin will dissolve and form a red solution. Now, putting the uninjured roots of a plant to dip in this solution, the roots become red externally and internally, and the red colour will extend for some way up their interior. Trying the same experiments with red particles of carmine, the carmine does not dissolve, it remains suspended in the water in the form of fine granules (like red mud), nor will any red colour pass into the root. Thus the eosin passes into the root because it is dissolved in water; the carmine remains outside the root because it is still solid and undissolved. *A flowering plant can absorb only liquids or gases: it cannot take in solid bodies.*

Roots pour out an acid substance which can dissolve some minerals in the soil.—If the roots of a plant be made to grow over and against a slab of marble, in time they make a pattern of themselves on the surface of the marble. This is due to the fact that the roots excrete a substance which corrodes the marble by dissolving it wherever the young root touches the surface. Placing a piece of blue litmus-paper against the absorbing part (see next paragraph) of a root, the paper gradually assumes a red colour, thus proving that the substance poured out by the root is of an acid nature.

Only the terminal portions of roots absorb liquids.—The region of the root a short distance behind the tip is the part which absorbs. This region is usually marked out by the possession of numerous root-hairs, which aid in the process of absorption. Sometimes the roots do not possess root-hairs; this is often the case with plants grown by means of culture-solutions, but still it is the same region of the root which takes in liquid. Hence, if we cut off all the younger terminal parts of roots the plant is liable to die.

CONDITIONS INFLUENCING THE ABSORPTION OF WATER BY ROOTS.

(Use the apparatus given in fig. 241 for these experiments.)

The **Temperature** of the soil, or of the culture-solution, affects the rate of absorption by roots. If we cool the culture-solution (by dropping pieces of ice into it or otherwise) the roots absorb

more slowly. There are *minimum*, *optimum*, and *maximum* temperatures for absorption (see page 194). During summer roots absorb more rapidly than in winter, for one reason, because the soil is warmer.

Strength of the solutions.—If we make the culture-solution gradually stronger and stronger, we find that, after a certain strength is attained, the root absorbs more and more slowly as the strength of the solution increases, till finally it practically ceases to take in any liquid. We thus see that *the root can take up only weak solutions of salts.*

Transpiration.—Again, carrying the plant into a better-lighted spot, or where there is a drier atmosphere, absorption increases in rapidity (see next chapter).

CHEMICAL ELEMENTS ESSENTIAL TO PLANT-LIFE, AND THEIR ABSORPTION.

It has already been stated that a plant may be successfully cultivated if supplied with the simple inorganic culture-solution, mentioned on page 191, if the atmospheric air is also accessible. In the solution and the atmosphere together there are the elements carbon, oxygen, nitrogen, hydrogen, sulphur, phosphorus, iron, calcium, magnesium, potassium (as well as common salt, which the plant can dispense with). Every plant requires all these elements: if it be deprived of one of them it cannot continue to live and grow. The first six elements are essential to build up protoplasm. Iron is required for the formation of chlorophyll. The carbon is taken in as carbon dioxide by the green parts. The last six elements must be absorbed by the roots, because they are not found in the atmosphere: they are absorbed in the form of salts in solution. Hydrogen and oxygen are taken in as water (H_2O). But oxygen and nitrogen, so far as we have yet learned in this book, might be absorbed from the air or from the soil, as they occur in both. The oxygen will be dealt with in a future chapter. There only remains nitrogen.

Absorption of Nitrogen.—Does the plant absorb the free nitrogen from the atmosphere by its shoot, or does it take nitrogen in by its roots? If we take away all the combined nitrogen (nitrates) from the culture-solution already described, and endeavour to grow a seedling of a Sunflower in the culture-solution thus impoverished, the plant remains stunted and soon

dies (fig. 242). It dies for want of nitrogen, though it has an inexhaustible supply of free nitrogen in the air around it and in the air dissolved in the culture-solution. This proves that the plant cannot obtain from the air the nitrogen it requires. The plant must have combined nitrogen—preferably nitrogen containing salts—supplied to its roots. Hence the roots absorb all the elements required by the plant with the exception of carbon.* The members of the Bean-family (*Leguminosæ*) form an apparent exception to this rule. They have peculiar swellings on their roots — the so-called *tubercles* or *nodules*—which are caused by microscopic fungi or bacteria. These *Leguminosæ* can live and grow vigorously when the nitrogen is supplied to them only in the form of free nitrogen gas. But if the roots of a leguminous plant are not infected with the tubercle-bacterium, the plant remains stunted and soon dies when not supplied with nitrates or other compounds of nitrogen. In some way the bacteria enable leguminous plants to employ free nitrogen as food.

Fig. 242. — Sunflower-plants. The two left-hand plants have been cultivated in a soil containing combined nitrogen in the form of potassic nitrate. The two right-hand plants have been cultivated in a soil similar, excepting that there is no combined nitrogen in it. (After A. Mayer.)

CURRENT OF WATER AND SALTS UP THE STEM TO THE LEAVES.

If we observe the amount of water absorbed by the roots dipping in a culture-solution, we see that it is many times as great as the volume of the roots. The roots are not large enough to have retained all the water they absorbed; it is therefore evident that some of the liquid must have passed up into the stem. Salts also are carried up into the stem and to the leaves, as is shown by the fact that large quantities of the

* The roots can also absorb organic carbon-compounds, though they cannot take in carbonic acid.

elements absorbed only by the roots are found in the stem and leaves. The water travels up the woody part of a stem. This can be demonstrated by cutting a ring of bark (right

Fig. 243.—Branch of a tree from which a ring of bark has been cut, with its lower end dipping in water.

down to the wood) from the stem or branch of a tree (see fig. 243). In spite of this injury to the stem the water continues to travel up, as is evident from the fact that the leaves attached above the ring-like cut do not wither (see next chapter) and the base of the stem or root continues to absorb water. It is not easy to prove that the salts dissolved in the water go up the wood with the water. But we can illustrate

the process by putting the cut end of a branch in a coloured watery solution (say of eosin). The colour gradually passes up the wood, and finally extends along the nerves of the leaves: thus showing that the colouring-matter travels up the wood with the water in which it is dissolved. If the branch has no general woody body, but possesses separate strings (vascular bundles) of woody tissue, the water and colouring-matter will travel up the isolated bundles.

CHAPTER XIX

TRANSPIRATION

If we measure the amount of water absorbed by a green plant grown by the aid of a culture-solution, we see that it soon exceeds the volume of the whole plant. This proves that not only does the plant absorb water by means of its roots, but that it also gives some water back to the air by the aid of its shoot. This fact is also shown by the familiar experience that a plant, or a cut shoot, withers if it be not supplied with water. In these cases the water passes off in the form of an invisible vapour: it is evaporated from the shoot of the plant. **The evolution of water in the form of a vapour from those parts of living plants which are in contact with the air is termed transpiration.** It is important to note especially that transpiration refers only to water given off in the form of a gas, and that it does not include water which exudes in the form of drops. As we shall see later, the leaves of some plants, in addition to transpiring, excrete liquid water.

How to measure transpiration.—(i.) *Method of weighing.*—We take a potted plant, cover the earth in the pot around the base of the plant's stem with a piece of tinfoil, and now weigh the plant, together with the pot and its contents. We weigh a second time after the lapse of an hour or two. The weight has decreased because the plant has lost water by transpiration. The loss of weight does not exactly represent the weight of water transpired, because the plant has become slightly heavier by reason of the carbon which it has absorbed from the atmosphere. But the gain in weight due to the absorbed carbon is so excessively small, compared with the weight of water transpired, that we may neglect it and regard the loss of weight as measuring the amount of water transpired. The tinfoil is placed over the soil in the pot in order to prevent water from evaporating from the surface of the soil. [This experiment is best performed on a fine day or in a dry room: see later.]

(ii.) *Cobalt paper method.* — If we soak some white filter-paper in a weak solution of cobalt chloride, and dry it near a fire or in the sunlight, the paper will assume a blue colour. When this blue paper is brought into contact with damp air it gradually assumes a red colour, and the damper the air is, the quicker does the red tint appear. Therefore, held near a transpiring leaf, the rate at which the blue paper turns red affords us a means of judging the speed at which the leaf is making the air around it damp, or, in other words, it shows us how fast the leaf is transpiring.

Leaves are the chief transpiring organs of a plant.—If we compare (by weighing) the rate at which two branches of a tree transpire, we find that a branch bearing many leaves transpires much faster than the branch having few leaves. Again, if we cut the leaves off a branch, we ascertain that the branch transpires very much more slowly than when the leaves were present. We therefore conclude that the leaves, exposing a large surface to the air, are the parts of a plant which are mainly responsible for transpiration; a green stem does transpire to a certain extent, but a woody stem scarcely transpires at all.

Usually the lower face of a leaf transpires more rapidly than the upper face.—We can easily prove the truth of this statement by experiments by the cobalt method on leaves of a plum, cherry, pear, oak, etc. The leaf is placed between two pieces of glass, with a piece of cobalt paper on part of each face. The cobalt paper in contact with the lower face soon becomes red, whereas the piece touching the other face remains blue for a longer period. This rule generally holds true only for leaves which are extended so as to have one surface pointing upwards and one facing downwards; leaves like those of the onion, which are nearly erect, transpire equally on all faces.

The rate of transpiration varies with the temperature of the air.—A plant placed in a warm position in a room transpires more rapidly than in a cool position in the same room. A rise of temperature causes a plant to transpire more rapidly, and a fall in temperature retards the process.

Light favours transpiration.—This may easily be illustrated by comparing the rate of transpiration of a plant or leaf at first placed near a window for a time and then taken into a darker part of the same room.

The rate of transpiration depends upon the moistness of the surrounding air.—A plant placed under a glass bell-jar soon begins to transpire very slowly, because the air becomes saturated with moisture; whereas if pieces of calcium chloride be suspended near the plant it transpires rapidly, because the calcium chloride sucks the moisture from the air and renders it dry. Thus we find the drier the air is the more rapidly a plant loses water by transpiration.

Movements of the Air (Wind) often increase the rate of transpiration.—This is not as easily proved in a simple manner, but a familiar fact illustrates its truth. Plants placed in draughty passages in a house are liable to wither and fade sooner than those placed in ordinary rooms, because they transpire more rapidly without being able to make up by a corresponding increase in the rate of absorption of water.

These facts explain various more or less familiar phenomena. Plants transpire more rapidly at daytime than by night, because the air is warmer and often drier, and because the leaves are exposed to light. Again, if cut flowers or shoots be placed at once in a dark box they remain fresh for a longer time than if they are exposed and carried for the same length of time in the hand. The fading is due to transpiration without corresponding absorption. In the dark box, transpiration is slower because of the absence of light and the stillness of the air inside the box, also because the air in the box soon becomes damp.

Function of Transpiration.—We have seen that the root absorbs water and dissolved salts, and that this solution is then carried up the stem to the leaves, and finally a large part of the water is returned to the air. Why should the plant take the trouble to drink in so much water, carry it up to the leaves, and then throw most of it away? Transpiration confers at least two important benefits on the plant. In the first place, the water transpired brings with it salts in solution: the salts are required as food. But the available salts are only present in the soil in the form of very weak solutions; and even if they were present in the form of strong solutions the roots could not absorb them. The result is that the plant is compelled to absorb a great quantity of salt-solution in order to obtain the salts it requires. The water is taken in largely in order that the plant may have the salts. When the solution

has travelled up to the factories of the plant—the leaves—the water has performed its carrying work and can be thrown away to make room for fresh supplies of salt-solutions. In the second place, transpiration helps to draw the salt-solution up the stem, and even causes the root to absorb liquids more quickly. It is easy to show that transpiration influences the rate at which the root takes in water: for if we place a glass bell-jar over a plant fitted into the apparatus figured on page 203, the root will gradually absorb more and more slowly as transpiration is retarded by the increasing moisture of the air under the bell-jar. Again, if we remove the bell-jar and transfer the plant and apparatus to a well-lighted window, the roots will absorb more rapidly than ever, because transpiration has been accelerated by the strong light. We can indeed use this fact as a rough method for judging of the rate at which transpiration is going on, merely measuring the speed at which absorption by the root, or the cut end of a stem, is proceeding. It is important to remember, however, that the root does not necessarily absorb the same quantity of water as the leaf transpires. Plants not watered, and plants whose roots are kept colder than the shoot, are liable to fade—that is, to lose more water than they absorb.

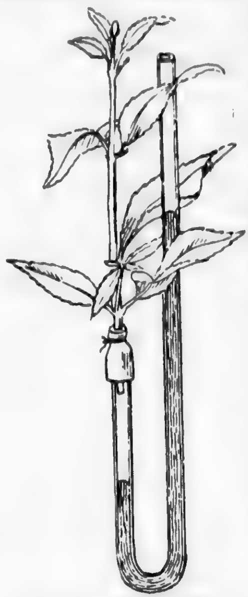

Fig. 244.—Apparatus for inducing the excretion of drops of water from cut shoots. The clear space below the plant-stem is occupied by water inside the short arm of the glass-tube: the water is being forced into the stem by mercury (which is shaded in the figure).

EXCRETION OF LIQUID WATER FROM LEAVES.

Early on a summer morning pearl-like drops of water may be seen glistening on the leaves of many plants. These are usually described as dew-drops—that is, they are supposed to have been derived from the air. Frequently, however, this description is incorrect, because the drops have been pumped out from the leaves. For instance, water is thus excreted from

the leaf-teeth of many plants (Buttercups, Poppies, Violet, Strawberry, Gooseberry and Currant trees, Foxglove, Daisy); from the leaf-tips of others (Grasses, Stitchwort); from spots on the leaf-margin (garden "Nasturtium"); or from the upper faces of the leaves. These drops appear especially when transpiration is slow, though absorption by the root is rapid. Consequently, if we place a potted plant under a bell-jar and warm the roots, we can easily induce the excretion of liquid water from the leaves. In most cases the water will not ooze from the leaves if the leaves or branches are removed from the plant, even if their ends are dipping in water. If, however, we force water up the cut end of the stem, by means of a column of mercury, as shown in fig. 244, water will more or less rapidly come from the leaves. This suggests that the root in some way pushes the water up the stem and forces it out of the leaves. But in some cases the water will appear even if the leaves are separated from the roots, as in the Fuchsia, just as sugar-solution will pour out of the nectaries of cut flowers

ROOT-PRESSURE.

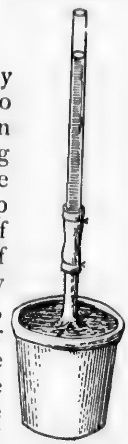

Fig. 245.

If we cut across the stem of a Vine in early spring, the cut surface of the stump attached to the root will "bleed": in other words, a solution is forced out of the cut surface. By fixing a long vertical glass tube to the stem, as in fig. 245, we see that the root is able to push the water high up the tube. The power which the root possesses of forcing water upwards is termed *root-pressure*. If we warm the roots the root-pressure is rapidly increased; cooling the roots has the opposite effect, so that the column of water remains stationary or rises slowly. Thus root-pressure depends on the rate at which the root is absorbing water. If the leaves of a plant are transpiring rapidly and we cut the stem across, we shall see no "bleeding," there is at first no sign of root-pressure, though in many plants it will appear after a time if the roots be kept warm and transpiration be arrested.*

* This absence of root-pressure in rapidly transpiring shoots does not imply that the force which causes root-pressure has stopped.

CAUSE OF THE ASCENT OF THE WATER UP THE STEM.

So far nothing has been said concerning the forces which cause water to travel from the root-stem up to the leaves. This question cannot be fully answered. There are two forces which aid the process—(i.) *Root-pressure* pushing the water up from the roots; (ii.) *transpiration* pulling the water to the leaves. Beyond these two bare statements it is impossible to go at present.

CHAPTER XX

RESPIRATION

In all the experiments previously described we have assumed that the shoot of the plant is supplied with atmospheric air. The green parts can take carbonic acid from the air. The free nitrogen of the air can be dispensed with. The question now arises "Does the plant require or use the free oxygen of the air?"

If we put a number of moistened germinating seeds, or young flowers (not green), into two bottles which we close up by means of air-tight corks, after a lapse of some (say twenty-four) hours changes have taken place in the air inside the bottle. We open one bottle, pour in some lime-water and shake it up. The lime-water becomes milky: thus showing that there is more carbonic acid in the contained air than there was at first. At the commencement of the experiment the lime-water would not become milky. We open the other bottle and thrust a lighted taper into it. The taper is at once extinguished: a fact which proves that the free oxygen inside the bottle has, wholly or partially, disappeared. These experiments illustrate the fact that growing flowering plants consume oxygen and give out carbonic acid. Another simple experiment proves the same. Before closing the bottle containing the seeds, we place in it a vessel containing a solution of potassic hydrate; we also fit a bent glass tube into the cork (as in fig. 246) and pour a coloured liquid into the tube. The liquid will stand at the same level in both arms of the tube. We then fit the cork into the bottle. The carbonic acid present in the air of the bottle will be constantly absorbed by the potassic hydrate. Now, if the seeds merely gave out this gas without taking in any other gas from the air, the amount of air inside the bottle would remain the same throughout the experiment and the liquid in the two arms of the tube would remain at the same level. (For, the decrease of the amount of

gas due to the absorption of the minute amount of carbonic acid present in the air at the commencement of the experiment would be imperceptible.) But we find that, on the contrary, the liquid rises in that arm of the tube which is in direct communication with the air inside the bottle (see fig. 246). This proves that the seeds are absorbing gas from the contained air. The absorbed gas is oxygen. The evolution of carbonic acid implies that the organic substance of the plant is being split up into simpler constituents, one of which is carbonic acid. Though it is not capable of simple proof, water is also produced as a result of this decomposition. The fact that the plant loses some of its solid substance by this process is well illustrated by the following experiment. Seeds or potato-tubers are germinated in darkness, being supplied only with air and pure (distilled) water. Growth continues for a time, but the plants are growing at the expense of the reserve-foods contained in their substance, for they are receiving no food capable of building up organic matter. After they have grown for a time we examine them chemically, and find (by calculation) that they contain less organic substance than they did in the seed- or tuber- condition. They have lost substance, particularly carbon, because of the evolution of carbonic acid gas derived from their organic substance. All the facts above cited prove that in actively-living plants there is a process going on by which the **organic matter of the plant is being broken down and carbonic acid is being evolved, and that the decomposition is accompanied by an absorption of oxygen. This process is termed respiration.**

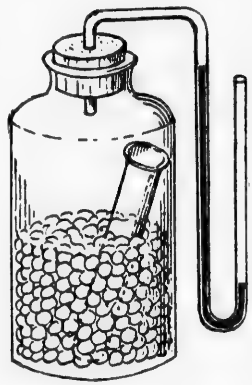

Fig. 246.

It will be noted that the process of respiration involves an excretion of carbonic acid and an absorption of oxygen. The assimilation of carbon by green parts exposed to light involves processes which are just the reverse. Hence it is not easy to prove that green parts of plants exposed to light are respiring; for, carbonic acid is being absorbed much more rapidly

than it is being excreted. Still, green parts can be shown to respire if they be kept in darkness. Respiration is always going on in actively-living parts, and in all parts of the plants. The absorption of carbonic acid by the plant only takes place in green parts, and only when the parts are exposed to light. There is another difference between respiration and the assimilation of carbon from carbonic acid. The volume of oxygen absorbed is not necessarily equal to the volume of carbonic acid released during respiration—in fact, the plant may for a time respire and evolve carbonic acid, when it is not provided with oxygen. Whereas, when carbonic acid is absorbed in the process of assimilation, an equal volume of oxygen is always released, and no oxygen is evolved unless carbonic acid is absorbed.

Free oxygen is essential to maintain the active life of a flowering plant.—Oxygen is not only absorbed by a plant, but it is absolutely indispensable. A pretty experiment illustrates this. Two bottles are obtained. Into one a little water is poured, and into the other pyrogallic acid dissolved in an equal amount of water. Two small moist sponges are selected, and cress seeds sown in the small holes of the sponge. The sponges are now suspended from the under-surface of the corks, which are fitted airtight into the two bottles (see fig. 247, which shows the complete apparatus). The seedlings soon germinate on the sponge which hangs in the air over the water. On the contrary, the seeds suspended over the pyrogallic acid do not germinate: the pyrogallic acid has absorbed all the oxygen from the air and so prevented growth. If we place a plant in an atmosphere devoid of oxygen, all the movements of the leaves and flowers which are signs of active life cease (see next chapter). We can now explain why land-plants which are too freely watered die. Gardeners say that their roots "rot away." The truth is that the earth becomes saturated with water which drives out the air contained in the soil, and in consequence the roots cannot obtain sufficient oxygen and die of suffocation.

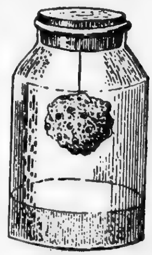

Fig. 247.

Conditions affecting respiration.—(i.) *Plants respire in light and darkness.* (ii.) *Oxygen.* In the absence of oxygen,

respiration continues for a time, but finally stops. This proves that *the absorption of oxygen increases respiration.* (iii.) *Temperature.* A rise in temperature up to a certain extent favours respiration. This can be proved by keeping germinating seeds in a cold place, when they will respire slowly. (iv.) *Rapidly-growing parts respire vigorously.* Any circumstances (fall in temperature, stopping supply of oxygen) calculated to stop growth, retard respiration. This is really putting "the cart before the horse," because the stoppage of growth is largely caused by the arrest of respiration, not *vice versâ*. A passive resting-seed or tuber respires very slowly indeed, but when growth commences, its respiration is rapid. (v.) *Only living parts of plants respire.* This is the most important fact of all, though not easy to prove. We can illustrate it by killing moistened seeds by means of boiling water, and comparing their effect on the air in a closed bottle with the effect produced by germinating seeds which are living.

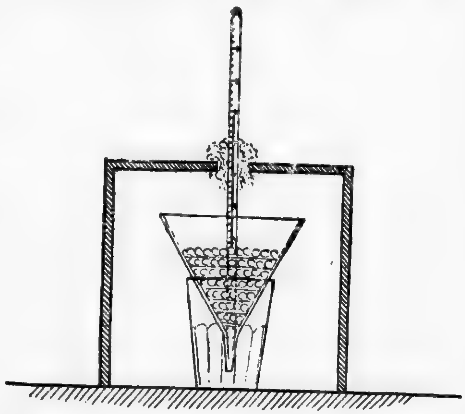

Fig. 248.—Apparatus to show the rise of temperature during respiration. A thermometer-bulb is surrounded by germinating peas, which are in a glass funnel. Outside is a reversed box, of wood or cardboard, through a hole in which the thermometer-tube passes.

Respiration causes a liberation of heat from the plant.—If a thermometer be plunged amongst a number of germinating seeds or young flowers, the mercury will rise, thus showing that the seeds are warmer than the surrounding general atmosphere. If the seeds be killed, there will be no appreciable change in the level of the mercury of the thermometer, thus proving that the rise of temperature is dependent on the parts being alive. In general, any conditions which retard respiration will cause the rise in temperature to be smaller.

CHAPTER XXI

GROWTH

Definition.—It is not easy to say exactly what we mean by the word growth. It does not denote simple increase in size or change in shape. A dead, dry bean-seed will swell when supplied with water; but if the dead bean-seed be dried once more, the bean shrinks to its former dimensions. If we supply water to a living bean-seed the latter does not merely become larger; a great change in the form ensues. The little embryo develops roots and stem and leaves. We know perfectly well that if we take away the water from the bean-seedling we cannot once more change it into a bean-seed. **Growth is a permanent change in the form of the plant, and can take place only in living parts.**

CONDITIONS ESSENTIAL TO GROWTH.

(i.) The plant must be **living.** (ii.) Only parts of a plant which are in a **youthful** (embryonic) **condition,** or can be brought into a youthful condition, are capable of growing. This statement can be proved only by the aid of the compound microscope, but it may be illustrated by examples. We know, for instance, that we continue to grow in height only up to a certain age. Again, the young growing points of roots and stems are the only parts of them which grow in length. In the grasses there is an apparent exception to this last statement, for the tissue just above the old nodes can grow; but this tissue really remains in a "youthful condition" in spite of age. (iii.) A supply of **water** is essential. Water is required, first, because it is a constituent of the living substance. Furthermore, it is a food-substance. In the third place, it serves to carry the nutrient substances to the growing parts. Finally, it keeps the fresh green parts of plants in a stiff and extended condition, as is proved by observing the process of fading or withering of drying parts of plants. (iv.) **Oxygen** is required

for respiration (see previous chapter). (v.) **Appropriate food material** is essential. The plant must have some food-bodies which it can convert into protoplasm and other substances constituting the body of the growing parts. This does not imply that the food-bodies must come from outside the growing plant. They may be already there, stored up as reserve material. Growth does not therefore necessarily imply an increase in the amount of solid substance composing the plant. Indeed, we have learnt that there is no increase in the dry weight of seedlings grown in darkness and supplied with only pure water and oxygen. (vi.) The **temperature** must be **suitable.** A plant placed in too hot or too cold a place will not grow.

GROWTH IN LENGTH.

It is more convenient and instructive to study growth in length of stems and roots than to follow their growth in thickness.

CIRCUMSTANCES INFLUENCING THE RATE OF GROWTH IN LENGTH OF STEMS AND ROOTS.

Temperature.—If we keep a plant in a very cold place its stem will not elongate; if we gradually raise the temperature, a point is reached at which the plant is just warm enough for the stem to commence to elongate. This is the *minimum* (or lowest) temperature for growth in length of the stem of that particular plant. Warming the plant still further, the stem elongates faster and faster as we raise the temperature up to a certain point. At this particular temperature the growth in length is most rapid; it is the best, or the *optimum*, temperature for growth in length (for that particular plant). If we still continue to place the plant in warmer and warmer places, every rise in temperature above the optimum causes growth to become slower and slower. We are, so to speak, overheating the plant. Finally, a temperature is reached which is the highest at which the stem can elongate—this is the *maximum* temperature. Placing the plant in a place the temperature of which is higher than the maximum, the stem does not elongate.

Effect of water supply.—If we do not supply water to a plant, growth in length of stem becomes gradually slower and slower till it ceases.

Effect of light.—We might expect that a stem exposed to the light would grow more rapidly than one kept in darkness. But our anticipations are not realised. Light retards the growth in length of a stem. In the case of the majority of plants which possess stems having internodes of easily perceptible length, the stem grows more rapidly in darkness. The plants grown in absence of light have thin stems with long internodes and small leaves; furthermore, they are devoid of chlorophyll. Such plants are said to be **etiolated**. In the case of plants like the Iris or Onion, with more or less erect radical leaves, the stem does not elongate abnormally in darkness, nor are the leaves dwarfed.

Nutation.—Even if every external influence (light, temperature, etc.) be kept unchanged, a stem does not grow evenly at its tip. Just behind the apex it grows more rapidly on one side than on the other, so that at this region the stem becomes a little longer on the more rapidly-growing side, and therefore bends over towards the opposite side. Soon the elongating part of the stem proceeds to grow more rapidly on another side, and the bend takes a new direction. Thus the end of the stem may be said to nod slowly, and the word *nutation* (nodding) is used to denote this phenomenon. Each growing part of the stem, which was originally bent by nutation, finally straightens itself before ceasing to elongate, so that a mature stem does not show the zig-zag course which it executed. This nutation of the stem may be seen especially clearly in twining plants.

All these variations in the rate of growth in length may be followed by using the method of making equidistant ink marks along the elongating parts of the stems (see page 5).

CIRCUMSTANCES INFLUENCING DIRECTION OF THE GROWTH IN LENGTH OF STEMS AND ROOTS.

Various external agencies influence not only the *rate* at which stems and roots elongate, but, to a certain extent, determine the *direction* in which those organs shall grow.

Heliotropism.—If potted plants be left for days undisturbed in front of a window, we know that their stems tend to point towards the window—that is, towards the light. Ordinary stems of flowering plants tend to grow towards the light, and to place themselves in a straight line with the source of the light.

To a certain extent many roots are affected also by the direction of the light falling on them; like the stems, they tend to place themselves (or rather their young growing parts) in the same line as the rays of light, but, unlike the stems, they grow directly away from the source of light. This influence of the *direction* of the rays of light upon the *direction* of the growth of parts of plants is described as *heliotropism*. The roots and stems thus affected are said to be *heliotropic*; the stem is described as *positively heliotropic*, because it grows towards the light, whilst the root is said to be *negatively heliotropic*, because it grows directly away from the source of light. Many roots, however, display only very slight, if any, heliotropism; many stems which are not erect are not positively heliotropic.

Geotropism.—We know that all bodies are attracted to the centre of the earth by the force of gravity. This force also influences the direction of the growth of stems and roots. If a bean-seed be germinated in absolute darkness, in whatever manner the seed be placed the main root will bend downwards, whereas the young stem will curve and grow vertically upwards. This behaviour is evidently not caused by the directive influence of light, because the seedling is in darkness. The end of the root does not bend downwards because of its weight, nor does it bend downwards because it is attracted by solutions of salts or water, for the root will force its way down into mercury which is much heavier than itself. If the bean-seedling be germinated on a slowly rotating vertical wheel, the roots and stems will not grow in any definite fixed direction, because gravity no longer acts on them in a constant direction. The influence which gravity exerts on the direction of growth on plants is described under the word *geotropism*. A main root is said to be *positively geotropic*, because it tends to place itself in the direction of the action of gravity and grows towards the centre of the earth. Many main stems and flowering axes are said to be *negatively geotropic*, because they tend to place themselves in the direction of the action of gravity but grow away from the centre of the earth. Lateral roots and lateral stems are influenced by gravity in a manner which cannot be discussed here.

Hydrotropism.—Many roots grow towards moisture in the soil, and are said to be *positively hydrotropic*.

In all these directive effects it must be noted that it is only the young elongating parts which respond to external influences (light, gravity, water), by curvatures or continued growth in one direction. Further, it must be noted that the ultimate direction assumed by a stem or root depends on the sum of all these influences (together with others not treated here). For instance, we often find that the directive influence of water on a main root frequently overpowers the directive influence of gravity, if the two influences are not working in the same direction. The consequence is that the root may not grow vertically downwards.

CHAPTER XXII

IRRITABILITY AND MOVEMENTS OF LIVING PARTS OF PLANTS

WHEN plants or animals are influenced by a disturbance in the world outside them, the effect produced is not so simple as is the case when dead bodies are acted upon. We may illustrate this statement by an example: Supposing we push a book along a table, we notice two facts with reference to the behaviour of the book. (i.) The amount of movement is exactly proportionate to each push we give. (ii.) The book moves in the direction of the push. We now consider an influence operating on a living organism. Suppose a tiny particle of food to enter the windpipe of a man, it may cause the man to cough so violently that many of the muscles of his body are called into play by the paroxysms. There is no proportion between the insignificant disturbing external cause (the particle in the windpipe) and the very great response. Again, if we place a bean-seedling on moist earth in a dark place in such a manner that its main root and main stem lie horizontal, when growth begins, the end of the stem will bend up, but the tip of the root will curve downwards. Thus the same disturbing cause (gravity), acting in same direction on the root and stem, occasions a different and even opposite response in the two parts of the plant. **This property of responding in a peculiar manner to external changes, and which is possessed only by living plants and animals, is termed irritability.** A disturbing external influence which is able to call forth a response is termed a *stimulus*.

PERIODIC MOVEMENTS OF LEAVES AND FLOWERS.

At night-time many leaves place themselves in postures different from those which they assume during the day, and execute movements to attain their day-position and night-position. These movements may be seen in the cotyledons of

certain plants (*e.g.* seedlings of the Sunflower and of *Stellaria media*), which either rise or sink as night sets in. The foliage-leaves of *Stellaria media* also move: at night the opposite leaves at each whorl incline towards each other with their tips pointing more or less towards the apex of the stem: at daytime these leaves diverge and stand out more nearly at right angles to the stem. In compound leaves the movements of the leaflets are even more striking. By day the three leaflets of a leaf of the Woodsorrel (*Oxalis acetosella*) are fully expanded and horizontal (fig. 249); but at night-time the leaflets droop vertically downwards, something like a closed umbrella (fig. 250). The leaves of the Dutch Clover (*Trifolium repens*) are expanded by day (fig. 251); but at night the three leaflets composing a leaf bend and fold so that the terminal leaflet forms a roof over the two lateral leaflets (fig. 252). The pinnate compound leaves of many Leguminosæ either rise or sink at night-time, and the opposite leaflets bend towards each other in pairs either upwards or downwards.

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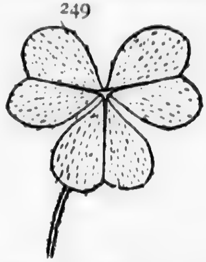

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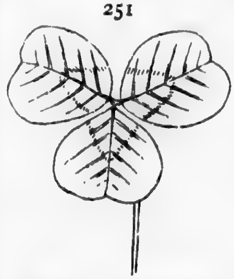
Fig. 249.—Compound leaf of Woodsorrel: day-position.
Fig. 250.—Ditto: night-position.

251



252

Fig. 251.—Compound leaf of Clover: day-position.
Fig. 252.—Ditto: night-position.

Many flowers and some inflorescences have different day- and night- positions. In most cases the flower or inflorescence (usually capitulum) is open at daytime (fig. 253), but closed by night (fig. 254); but each flower has its own opening and closing time. The accompanying table shows the opening and closing times of some flowers and inflorescences; it also shows

that some flowers (*e.g. Lychnis vespertina*) are closed by day but open by night.

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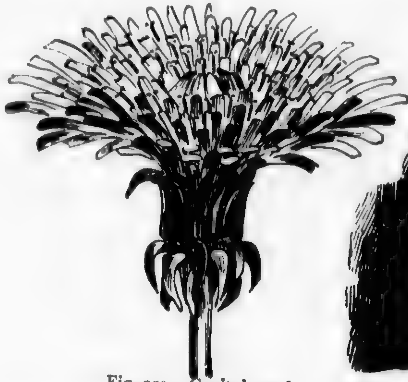

Fig. 253.—Capitulum of Dandelion open.

254

Fig. 254.—Ditto closed.

NAME.	Opening Time.	Closing Time.
Capitulum of *Tragopogon pratense* ("Go to bed at noon").	4-5 A.M.	9-10 A.M.
Capitulum of *Taraxacum officinale* (Dandelion).	5-6 ,,	5 P.M.
Flower of *Anagallis arvensis* (Scarlet Pimpernel, Poor-man's Weather-glass).	8 ,,	
Capitulum of *Calendula arvensis* (Marigold).	9 ,,	
Flower of *Lychnis vespertina* (Evening *Lychnis*).	7 P.M.	

IRRITABILITY OF MOVING ORGANS.

These regularly recurring (periodic) movements of leaves and flowers are liable to be disturbed by changes in the temperature or moisture of the air, or by changes in the illumination of the plant. These changes act as stimuli and cause "*induced movements.*" If at daytime we put a Clover

plant or a Daisy-plant in a dark place, the leaves of the former and the capitula of the latter will close up. Here the sudden removal of light acts as a stimulus, and the irritable part of the plant responds by closing. Bringing these plants back into the light, the leaves and inflorescences open. Again, if we put a Tulip-plant with fully-developed but closed flowers into a warm place, we can cause the flowers to open. When the flowers are open and the plant is transferred to a cold place, the flowers commence to close. Here the rise or fall of temperature acts as a stimulus. (Similar observations may be made on the *Crocus.*) Finally, we know that the flowers of *Anagallis arvensis* (the Poor-man's Weather-glass) will close at daytime if the air be damp and the weather dull.

These movements induced by stimuli enable us to illustrate the meaning of irritability. If we kill the plants before trying these experiments, the leaves and flowers will not respond to the stimuli (of light, heat, etc.). This illustrates the fact that only living plants (and animals) are irritable. But we can render plants non-irritable without killing them. [illegible], for instance, we expose them to chloroform-vapour, or keep them in a cold place, or in darkness for a considerable time, they are rendered incapable of responding to stimuli: they are no longer irritable. Restoring these plants to their ordinary surroundings, they may soon re-acquire their irritability and execute movements when stimulated by light, heat, etc. These experiments incidentally show us that light and heat may act on a green flowering plant in two different manners. In the first place, light and heat serve to keep the plant healthy, so to speak, and thus enable it to respond to stimuli. A green plant immured in darkness for a considerable time or kept in a cold place becomes ill and loses its irritability. Thus we may say that heat and light exert a *tonic* influence on plants. In the second place, when the plant is in a tonic (healthy) condition sudden changes in temperature or light act as stimuli and may cause movements. Thus light and heat also exercise *stimulating* influences on the plant.

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APPENDIX *

ON TECHNICAL TERMS

PLANT.

I. **Arboreous** or **arborescent** plant = a tree. **Fruticose** or **frutescent** plant = a shrub. **Suffruticose** or **suffrutescent** plant = an under-shrub, a sub-shrub—*i.e.* a plant having deciduous herbaceous upper parts and a perennial woody base. **Bush** = a low much-branched shrub. **Terrestrial** = growing on land. **Aquatic** = growing in water. **Parasite** = a plant growing attached to, and deriving food from, another living plant or a living animal. **Epiphyte** = a plant living attached to another plant, but deriving no food from the latter. **Saprophyte** = a plant feeding upon decaying animal- or vegetable-remains.

ROOT.

II. **Root-fibres** = the slender elongated portions of roots. **Tap-root** = a stout vertically-descending main root, with or without small branches. A root is **fibrous** when it is devoid of a tap-root and consists of a number of long fibres. A root is **tuberous** when it is thickened to form short swollen masses termed **root-tubers**. **Fusiform** = spindle-shaped. **Spongiole** = the root-tip. **Pileorhiza** = root-cap. **Coleorhiza** = an additional sheath encasing the root and root-cap of a grass-embryo in the seed. **Endorhizal** = having the root of the embryo encased in an additional sheath. **Exorhizal** = not having the root of the embryo encased in an additional sheath.

STEM.

III. **Tigellum** = the main stem of the embryo in a seed; sometimes is used as a synonym of the word plumule, which denotes the shoot of the embryo in the seed.

IV. Adjectives denoting the direction of growth of stems which are above ground.—**Erect** = upright. **Flexuous** = zig-zag. **Procumbent** or **prostrate** = trailing along the ground. **Diffuse** = procumbent and copiously,

* This Appendix is intended merely for use as a Dictionary in case of necessity; on no account should it be studied: for it contains not only many terms which are useless or obsolete, but also some which are actually incorrect or misleading.

also loosely, branched. **Creeping** = trailing and giving off adventitious roots from the stem; the term creeping is also sometimes applied to subterranean horizontally elongated rhizomes. **Tufted** or **cæspitose** = when a number of short stems, closely set, spring from the rhizome. **Scandent** = climbing. **Voluble** = twining.

V. Characteristic types of stems.—**Flagellum** or **runner** = a creeping stem with long whip-like internodes, and with foliaged tufts at the nodes. **Offset** is similar to a runner, but has shorter internodes. **Stolon** = a trailing or descending branch which dips into the soil and gives off adventitious roots. **Stoloniferous** = possessing stolons. **Sucker** = a new stem rising above the soil from, and produced by, a subterranean horizontal stem or root. The term sucker is also applied to the sucking root-like organs by means of which parasites absorb food from the plants on which they live. **Phylloclade** = cladode. **Culm** = a jointed stem like that of a grass. **Fistular** stem or leaf is one which is hollow along its whole length. **Scape** = a stem rising from the ground, not bearing any cauline foliage-leaves, but terminating in a flower or an inflorescence. **Bulbils** = small axillary buds which separate from the mother-plant and become distinct individuals.

VI. Growth in thickness of stems.—**Endogenous** = not undergoing secondary increase in thickness; an **Endogen** is a Monocotyledon. **Exogenous** = undergoing secondary increase in thickness; an **Exogen** is a Dicotyledon. These obsolete meanings attached to the words Endogenous and Exogenous are widely different from the meanings given to them in the body of this book and in other modern text-books.

VII. A plant is **acaulescent** when it possesses no foliaged stem rising appreciably above the ground. **Root-stock** = rhizome.

LEAVES.

VIII. **Phyllotaxis** = leaf-arrangement. **Opposite** = whorled with only two leaves at each node. **Decussate** = opposite with the leaves at the successive nodes alternating. **Verticillate** = whorled. **Scattered** = alternate. **Di-, tri-, tetra-, penta-stichous** = alternate, and forming two, three, four, five longitudinal rows respectively. **Cauline** leaves, as opposed to radical leaves, are leaves inserted on a distinct sub-aerial stem.

IX. Adjectives referring to the base of a leaf.—**Amplexicaul**, the leaf sessile and embracing the stem at right angles. **Sheathing** = forming a sheath round the stem. **Perfoliate**, the stem appears to pierce the base of the leaf. **Connate**, the bases of opposite leaves joined together. **Decurrent**, the margins of the leaf seem to be continued down the stem as ridges.

X. Stipules.—**Foliaceous** = leaf-like. **Adnate**, as in the Rose. **Axillary**, when only one is present and it is on the axillary face of the leaf. **Interpetiolar**, when one stipule is present between each two adjacent leaves in whorled types. **Ochreate** = tubular and embracing the stem; an ochreate stipule is termed an **ochrea**. **Caducous** = falling when the leaf completely unfolds from the bud. **Persistent** = lasting as long as the other parts of the leaf.

XI. Petiole.—**Phyllode** = a flattened leaf-like petiole of a leaf which is usually devoid of a lamina.

XII. Shape of the lamina.—**Capillary** = thin and flexible, like animal hairs. **Filiform** = thread-like. **Acicular** (fig. 264). **Linear** (fig. 265).

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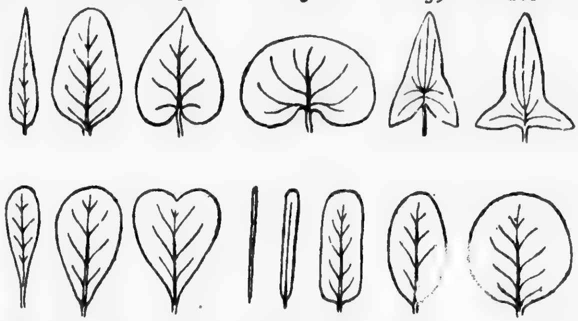

261 262 263 264 265 266 267 268

Subulate = awl-shaped. **Lanceolate** (fig. 255). **Oblong** (fig. 266). **Elliptical** (fig. 267). **Ovate** (fig. 256). **Orbicular** or **rotund** (fig. 268). **Angular** = having three or more angles. **Deltoid** = like the Greek letter **Δ**. **Obovate** (fig. 262). **Cuneate** = wedge-shaped and attached by its point to the petiole. **Spathulate** (fig. 261). **Cordate** (fig. 257). **Obcordate** (fig. 263). **Reniform** (fig. 258). **Auriculate**, when the base of the lamina assumes the form of two ear-like processes (**auricles**). **Sagittate** (fig. 259). **Hastate** (fig. 260). **Ensiform** = sword-shaped. **Falcate** = sickle-shaped. **Peltate** = shield-like (as in *Tropæolum*).

XIII. Apex of the lamina.—**Acuminate** (fig. 269-IV). **Acute** (fig. 269-III). **Obtuse** (fig. 269-II). **Truncate** = ending abruptly as if cut across. **Emar-**

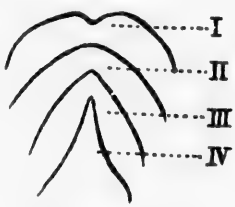

Fig. 269.

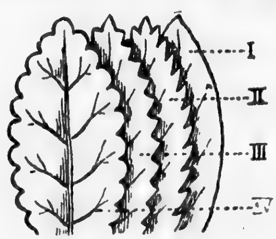

Fig. 270.

ginate (fig. 269-I). **Mucronate** = ending in a special pointed prolongation of the mid-rib. **Apiculate** = ending in a short small point.

XIV. Margin of the lamina.—**Entire** (fig. 270-I). **Serrate** (fig. 270-II). **Dentate** (fig. 270-III). **Denticulate** = with very small teeth. **Crenate** (fig. 270-IV). **Sinuate** = wavy. **Ciliate** = fringed with hairs.

XV. Division and lobing of the lamina.—**Cleft**, or termination **-fid**,

when the incisions reach half-way, or nearly so, to the middle of the leaf and divide the leaf into **laciniæ**; **pinnatifid** (fig. 21), **palmatifid** (fig. 25). **Runcinate** = pinnatifid with the pointed lateral sub-divisions directed towards the base of the leaf (*e.g.* Dandelion). **Pectinate** = pinnatifid in a comb-like manner. **Parted**, or the termination **-partite** = when the incisions reach more than half-way, but not more than three-quarters of the distance, to the middle of the lamina and divide it into **partitions**: **pinnatipartite** (fig. 22), **palmatipartite** (fig. 26). The termination **-sect** = when the incisions reach more than three-quarters of the distance towards the middle of the lamina and divide it into segments which are not yet leaflets. **Lyrate** = lyre-shaped, when sub-divided in a pinnate manner with a long terminal sub-division. **Laciniate** = divided by deep and irregular incisions into a great number of unequal sub-divisions. **Lobed**: in some books a lamina divided to any depth in such a manner that the sub-divisions have rounded ends is said to be lobed: and the sub-divisions are **lobes**: **pinnately-lobed, palmately-lobed. Pinnate-leaves** = pinnately compound: **Rhachis, rachis**, the part of a pinnately compound leaf which corresponds with the mid-rib of a simple pinnately-nerved leaf; **imparipinnate** = pinnately compound with a terminal leaflet; **paripinnate** = pinnately compound without a terminal leaflet; **bipinnate** = doubly or twice pinnately compound. Palmately compound = **digitate**; **ternate** = having three leaflets; **quinate** = having five leaflets.

XVI. **Præfoliation** = vernation. **Plane** = flat (figs. 29, 32). **Reclinate** = with the upper half of the leaf folded transversely upon and against the lower half. Folded sideways: **conduplicate** (figs. 30, 33); **plicate** = **plaited** (fig. 34). **Circinate** = the apex of the leaf rolled transversely upon the more basal parts. Rolled sideways: **convolute** (fig. 37); **involute** (fig. 35); **revolute** (fig. 36).

XVII. Vernation and æstivation.—**Induplicate** (fig. 31) when the leaves are open or valvate, and have their margins rolled inwards. **Equitant** when each leaf, or its base, embraces its successor just as a saddle fits on a horse's back.

TEXTURE—CONSISTENCE OF PLANT PARTS.

XVIII. **Scarious** = thin, dry, and stiff. **Membranous** = thin, easily flexible, and more or less transparent. **Coriaceous** = tough, leathery. **Succulent** = juicy. **Rigid** = resistent.

SURFACE, HAIRS, Etc.

XIX. **Glabrous** = without hairs. **Smooth** = without hairs or any roughness. **Pubescent** = downy, coated with soft short hairs. **Pilose** = with scattered long soft hairs. **Hirsute** = with numerous long rather soft hairs. Hairs **adpressed** = when lying flat against the surface. **Silky** = with long shining close-pressed hairs. **Tomentose** = cottony = with matted soft hairs. **Woolly** = with curly wool-like soft hairs. **Hispid** = with stiff bristly hairs. **Setose** = with very stiff bristles. **Echinate** = **aculeate** = furnished with prickles. **Spinose** = furnished with spines: or being a spine. **Spinulose** = with minute spines. **Rugose** = wrinkled. **Tuberculate** = beset with many small wart-like outgrowths. **Punctate** = dotted. **Striate** = with parallel

lines, either slightly raised or specially coloured. **Sulcate** = with parallel furrows. **Costate** = with parallel ribs or ridges. **Winged** = with longitudinal flap-like ridges along the sides. **Scabrous** = rough. **Viscous** = **viscid** = sticky. **Glaucous** = covered with a whitish layer of "bloom" which modifies the tints of the underlying surface (*e.g.* Plum-fruits, Cabbage-leaves).

INFLORESCENCE.

XX. Axis.—**Peduncle** = the main axis of an inflorescence, whether the latter consists of many flowers or of one solitary flower. **Pedicel** = the stalk of one single flower in an inflorescence. **Rhachis, rhachis** = the elongated flower-bearing part of an inflorescence-axis.

XXI. Bracts.—**Bracteoles** = the bracts on a single flower-stalk in an inflorescence. **Phyllaries** = the bracts forming the involucre amongst Compositæ. **Paleæ** = chaffy bracts on the receptacle of capitula, and in spikelets of Grasses.

XXII. Inflorescence.—**Centrifugal** = with flowers opening from the centre outward, as in cymose types. **Centripetal** = with flowers opening from without towards the centre—*i.e.* in acropetal succession, as in most racemose types. **Uniparous** cyme = a monochasium. **Helicoid** cyme = a kind of monochasium. **Biparous**, or **dichotomous**, cyme = a dichasium. **Fascicle** = a crowded cymose inflorescence resembling an umbel and corymb combined (*e.g.* Sweet William). **Glomerule** = a crowded cymose inflorescence resembling a capitulum or a shortened spike. **Verticillaster** = an inflorescence consisting of opposite axillary sessile cymes which form a false whorl. **Thyrsus** = a panicle-like cyme; or more accurately an inflorescence the main type of which is racemose, but the secondary or ultimate branches of which are cymes. **Strobilus** = **cone**, as applied to Angiosperms, is a spike with large bracts; as applied to Gymnosperms, it is a single flower conical in form. **Locusta** = spikelet. **Corymb** = an inflorescence like a simple raceme, except that the stalks of the lower flowers are longer than those of the upper ones, so that all the blossoms of the inflorescence reach about the same level.

FLOWER.

XXIII. **Dichlamydeous** = with a perianth consisting of two whorls. **Monochlamydeous** = with a perianth consisting of one whorl. **Achlamydeous** = naked = without a perianth. **Asepalous** = without sepals. **Complete** = having all four kinds of floral leaves. **Incomplete** = not having all four kinds of floral leaves. **Perfect** = **bisexual** = **hermaphrodite** = monoclinous. **Imperfect** = **unisexual** = diclinous. Sometimes the words perfect and imperfect are used as synonyms of complete and incomplete respectively. **Male** = staminate. **Female** = **pistillate** = carpellary. **Neuter** = devoid of stamens and carpels. **Barren** or **sterile** = incapable of producing seeds: sometimes used as synonyms of staminate. **Fertile** = producing seeds: sometimes employed as a synonym of carpellary. **Dimorphic** = having monoclinous flowers of two kinds. **Trimorphic** = having monoclinous flowers of three kinds.

XXIV. Number of parts.—A flower or a whorl is **di-**, **tri-**, **tetra-**, and **penta-merous**, when its floral leaves are in twos, threes, fours, and fives respectively. **Isomerous** = in number equal to the sepals or petals forming

one whorl. **Anisomerous** = in number unequal to sepals and petals which form one whorl.

XXV. Duration of floral leaves.—**Anthesis** = the time during which a flower is in the blossoming (open) stage: or the act of opening of the flower. **Persistent** = remaining until the fruit is matured. **Marcescent** = withering without falling. **Deciduous** = falling before the fruit forms. **Fugacious** = falling or decaying in one day. **Caducous** = falling as the flower opens.

RECEPTACLE.

XXVI. **Torus** = **thalamus** = receptacle. **Calyx-tube** = concave receptacle. **Carpophore** = that portion o. the axis which is prolonged between the carpels of a syncarpous ovary in the fruiting stage (*e.g. Geranium*, Parsley). **Stipitate**: any part of a flower which is usually devoid of a stalk is said to be **stipitate** when it is specially stalked (*e.g.* stipitate pappus of the Dandelion).

SHAPE OF THE PERIANTH (INCLUDING THE CALYX AND COROLLA).

XXVII. **Mono-**, **syn-** = gamo- -sepalous or -petalous. **Chori-**, **dialy-** = poly-sepalous or -petalous. When a sepal or petal has a narrow claw it is said to be **unguiculate**. When gamosepalous or gamopetalous the combined portion is the **tube**, the free portions form the **limb**, and the region at the junction of the limb and tube is the **throat** (**faux**).

XXVIII. Regular forms.—**Rotate** = wheel-shaped (fig. 271). **Campanulate** = bell-shaped or cup-shaped. **Urceolate** = pitcher-shaped, with the

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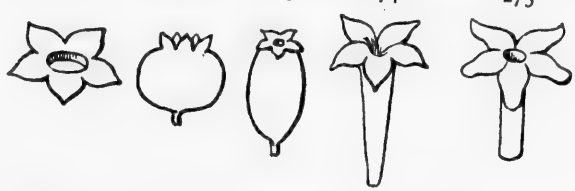

tube swollen in the middle and narrowed at the top (fig. 273). **Bladdery** = **inflated** = dilated like a bladder (fig. 272). **Infundibulum** = funnel-shaped (fig. 274). **Turbinate** = top- or pear-shaped. **Crateriform** = saucer-shaped. **Tubular** = cylindric. **Hypocrateriform** = salver-shaped (fig. 275).

XXIX. In regular or irregular forms.—**Calcarate** = **spurred** = having a deep pointed bag termed a **spur**. **Saccate** = having a shallow rounded bag. **Gibbous** = having a slight projection.

XXX. Irregular forms.—**Bilabiate** = two-lipped. **Ringent** = gaping, is a term applied to a two-lipped gamopetalous corolla when the entrance to the tube is clearly open. **Personate** = masked, is a term applied to a two-lipped gamopetalous corolla when the entrance to the tube is blocked by a projection—the **palate**—from one of the lips (*e.g.* Snapdragon).

ANDRŒCIUM.

XXXI. **Male** parts or organs of a flower = stamens.

XXXII. Number of stamens.—**Isostemonous** = equal in number to a single whorl of the perianth. **Diplostemonous** = having twice as many stamens as there are members in one whorl of the perianth, and the stamens alternating correctly. **Mon-, di-, tri-, pent-, dec-,** or **poly-androus** = having one, two, three, four, five, ten, or indefinite (more than twelve) stamens respectively in a flower.

XXXIII. Length of the filaments.—**Included** = with the anthers not reaching beyond the corolla. **Exserted** = with the anthers protruding beyond the corolla or corolla-tube. **Declinate** = with the stamens exserted and all bent to one side. **Didynamous** = when the andrœcium consists of four stamens, two of which have longer filaments than the other two. **Tetradynamous** = when the andrœcium consists of six stamens of which four have longer filaments than the other two.

XXXIV. Cohesion.—**Mon-, di-, tri-,** or **poly-adelphous** = with the filaments united to form one, two, three, or many bundles respectively. **Syngenesious** = with the anthers combined.

XXXV. Anther.—**Cells** = the chambers of the mature anther. **Quadrilocular** = four-celled, when the four pollen-sacs remain distinct in the ripe anther. **Bilocular** = two-celled, when two cells are formed by the fusion in pairs of the four pollen-sacs. **Unilocular** = one-celled, usually because only half the anther is present and its two pollen-sacs combine. **Theca** = anther-lobe. **Dithecous** = with two lobes, therefore being a complete anther. **Monothecous** = with one anther-lobe, therefore representing only half an anther. **Dimidiate** = having only one lobe, because the other is suppressed or nearly so. **Adnate** = **dorsifixed** = when the direct continuation of the filament appears to run up the whole length of the anterior or posterior surface of the anther: the anther is therefore either introrse or extrorse in insertion. **Innate** = **basifixed** = when the continuation of the filament appears to run up the centre of the anther, and the anther seems to constitute the actual end of the stamen: dehiscence is usually marginal. **Versatile** = when the anther is attached to the filament only at a single point so that it can swing freely. **Apicifixed** = **suspended** = when the anther hangs so as to appear to be fixed by its top to the filament. The direction of the two anther-cells or two anther-lobes is either **parallel** or **diverging** at an angle. **Divaricate** = when the two lobes diverge so much that they appear to be placed end to end. **Didymous** = when the two lobes combine at a point above their middle. **Two-horned** = when the two erect anther-lobes diverge above. **Sagittate** = when the anther-lobes diverge below so that the anther is shaped like an arrow-head. **Appendiculate** = bearing appendages. **Sutural** dehiscence = longitudinal dehiscence. **Opercular** dehiscence = valvular dehiscence.

GYNÆCIUM.

XXXVI. **Pistil** = gynæcium: in some books, however, the term pistil is used to denote a single ovary with a style and stigma, in which case the Buttercup-flower, for instance, has a number of pistils. **Female** parts or organs of a flower = carpels. **Mono-, bi-, tri-,** and **poly-carpellary** = gynæcium consisting of one, two, three, and many carpels respectively.

Mono-, **bi-**, **tri-gynous** are vague terms occasionally used as synonyms of terms explained in the preceding sentence.

XXXVII. Style.—**Terminal** = attached to the top of the ovary. **Lateral** = **ventral** = attached to the side of the ovary. **Basilar** = attached to the base of the ovary. **Gynobasic** = when the ovary has several distinct lobes but only one single style, which is attached to the base of the lobes at their central point of junction (*e.g.* Labiatæ).

XXXVIII. Stigma.—**Capitate** = ending in a rounded head.

XXXIX. Ovary.—**Simple** = consisting of one carpel. **Compound** = syncarpous. **Loculus** = cell = chamber. **Uni-**, **bi-**, **tri-**, **quadri-**, and **pluri-** or **multi-locular** = having one, two, three, four, and many chambers respectively. **Dissepiment** = **septum** = partition.

XL. Ovule.—**Nucleus** = nucellus. **Foramen** = micropyle. **Chalaza** = the region at which the integuments are attached to the base of the nucellus. **Hilum** = the region of attachment of the ovule to the funicle. **Raphe**, **Rhaphe** = the ridge which denotes the course of the funicle up the side of an inverted ovule; it connects the hilum and chalaza: the raphe is **ventral** when it is on that side of the ovule which faces the placenta, and consequently is between the placenta and micropyle; it is **dorsal** when it is on the side away from the placenta, so that the micropyle is situated between the placenta and the raphe; finally the raphe is **lateral** when it lies between the ventral and dorsal positions. **Primine** (testa) = the outer integument. **Secundine** (tegmen) = the inner integument. **Amphitropous** = half-inverted—that is, between anatropous and orthotropous. **Erect** = standing upright from the floor of the ovary-chamber. **Ascending** = directing obliquely upwards from an axial or parietal placenta. **Horizontal** = directed horizontally from an axial or a parietal placenta. **Pendulous** = directed obliquely downwards from an axial or a parietal placenta. **Suspended** = hanging vertically downwards from the roof of the ovary-chamber.

POLLINATION AND FERTILISATION.

XLI. **Fecundation** = fertilisation. **Fertilisation** = a term used in many books to denote pollination. **Autogamy** = self-pollination. **Allogamy** = cross-pollination. **Geitonogamy** = pollination by pollen from another flower on the same individual plant. **Entomophilous** = insect-pollinated. **Anemophilous** = wind-pollinated. **Dichogamy** = the ripening of the stamens and carpels of one flower at different times.

SEED.

XLII. **Spermoderm** = **testa** = the coat of a seed; or if the coat be double it is the outer layer, and the inner layer is the **tegmen** or **endopleura**. **Albumen** = the endosperm or perisperm, or both together, in a seed. **Albuminous** = possessing albumen. **Exalbuminous** = devoid of albumen. **Aril** = a special accessory envelope outside the testa and partially encasing a seed. **Strophiole** and **caruncula** = peculiar single outgrowths on seeds (*e.g.* Violet).

FRUIT.

XLIII. **Aggregate** fruit = compound fruit. **Multiple** or **collective** fruit = infructescence. **Pseudocarp** or **false fruit**; in some books a fruit is defined

as being the ripened seed-containing carpels of a single flower, and fruits into whose composition other parts enter are described as pseudocarps or false fruits (*e.g.* Strawberry, Rose). The **pericarp** of a fruit is often distinguishable into two or three layers; an outer one—the **epicarp** or **exocarp**; an inner one—the **endocarp**: and when a third layer is present, a middle one —the **mesocarp**. **Putamen** = a stone-like endocarp. **Pyrene** = a stone of a drupe. A **capsule** with longitudinal dehiscence along the ventral sutures is **septicidal**; along the dorsal sutures is **loculicidal**; and finally, when dehiscing so that the valves separate from the partitions of the ovary it is **septifragal**. **Pyxis** = **pyxidium** = a capsule with transverse (**circumscissile**) dehiscence. **Lomentum** = a pod-shaped fruit which breaks transversely into closed one-seeded joints. **Glans** = a nut with an involucre. **Cypsela** = an inferior achene like that of the Compositæ. **Nucule** = nutlet (*e.g.* Labiatæ). **Cremocarp** = **diachenium** = the schizocarp of Umbelliferæ. **Carcerulus** = an indehiscent several-chambered dry fruit (*e.g.* Labiatæ). **Pepo** = a berry like a cucumber or gourd. **Hesperidium** = a berry like an orange. **Æterio** = **eterio** = a compound fruit like that of the Buttercup (an æterio of achenes) or that of the Blackberry (an æterio of drupes). **Drupel** = a drupe of a compound fruit. **Cynarrhodium** = a compound fruit like that of the Rose. **Syconium** or **syconus** = an infructescence like the "Fig-fruit." **Sorosis** = an infructescence like a "Pine-apple" or a "Mulberry."

TERMS APPLIED TO VARIOUS PARTS.

XLIV. **Arcuate** = bent like a bow. **Aristate** = having a thread-like, usually stiff, termination or appendage: having an awn. **Articulate** = jointed. **Elongate** = at least three times as long as broad. **Globose** = approximately spherical. **Inflexed** = bent inwards or towards the upper face. **Reflexed** = bent outwards, backwards, or towards the lower face. **Rostrate** = ending in a straight elongated beak-like process.

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APPENDIX.

A MANUAL

OF THE

MORE COMMON

HERBACEOUS PLANTS

OF

QUEBEC AND ONTARIO

FOR USE IN CONNECTION WITH GROOM'S BOTANY.

(ADAPTED FROM GRAY'S MANUAL.)

BY

D. P. PENHALLOW, B. Sc.

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ANALYTICAL KEY TO THE ORDERS.

BRANCH I.—SPERMATOPHYTA.

CLASS I. ANGIOSPERMÆ. Pistil consisting of a closed ovary. Cotyledons only two.

SUB-CLASS I. DICOTYLEDONS or EXOGENS. Stems with bark, wood and pith; leaves netted-veined; embryo with two cotyledons; flower on the plan of four or five.

DIVISION I. POLYPETALÆ: the calyx and corolla both present; the latter of *separate* petals.

A. *Stamens numerous, at least more than 10, and more than twice the sepals or lobes of the calyx.*

1. *Calyx entirely free and separate from the pistil or pistils.*

PAGE

Pistils numerous, separate, but concealed in a hollow receptacle.
Leaves alternate, with stipules. . . . Rosa, in ROSACEÆ 76

Pistils more than one, separate, not enclosed in the receptacle.
Stamens inserted on the calyx, distinct. . . . ROSACEÆ 66
Stamens united with the base of the petals, monadelphous.
. . . . MALVACEÆ 40
Stamens inserted on the receptacle.
Filaments longer than the anther.
Flowers diœcious; twiners with alternate leaves.
. . . . MENISPERMACEÆ 11
Flowers perfect; if climbers, the leaves opposite.
Leaves not peltate; petals deciduous. . RANUNCULACEÆ 2
Leaves peltate; petals persistent.
. . . . . . Brasenia, in NYMPHÆACEÆ 14

Pistils several, their ovaries cohering in a ring around an axis.
. . . . MALVACEÆ 40

Pistils strictly one as to the ovary; the styles or stigmas may be several.
Leaves punctate under a lens with transparent dots.
. . . . HYPERICACEÆ 38

Leaves not punctate with transparent dots.
Ovary simple, 1-celled, 2-ovuled. . . . ROSACEÆ 66
Ovary simple, 1-celled, with one parietal many-ovuled placenta.
Leaves 2–3-ternately compound or dissected. . . . . RANUNCULACEÆ 2
Ovary compound, 1-celled, with a central placenta. . . . . PORTULACACEÆ 37
Ovary compound, 1-celled, with two or more parietal placentæ.
Calyx caducous; juice milky or colored. . PAPAVERACEÆ 16
Calyx persistent, of 3 or 5 sepals. . . CISTACEÆ 28
Ovary compound, several-celled.
Calyx valvate in the bud, and
Persistent; stamens monadelphous; anthers 1-celled. . . . . MALVACEÆ 40
Deciduous; anthers 2-celled . . . TILIACEÆ 41
Calyx imbricated in the bud, persistent.
Aquatic or marsh herbs; ovaries many,
On 5 placentæ in the axis. . . SARRACENIACEÆ 16
On the 8–30 partitions. . . . NYMPHÆACEÆ 13

2. *Calyx more or less coherent with the surface of the (compound) ovary.*

Ovary 8–30 celled; ovules many, on the partitions; aquatic. . . . . NYMPHÆACEÆ 13
Ovary 10-celled; cells 1-ovuled. . Amelanchier, in ROSACEÆ 80
Ovary 2–5-celled.
Leaves alternate, with stipules. . . Pomeæ, in ROSACEÆ 67
Leaves opposite, without stipules . Some SAXIFRAGACEÆ 80
Ovary one-celled, with the ovules rising from the base. . . . . PORTULACACEÆ 37

B. *Stamens of the same number as the petals and opposite them.*

Pistils 3–6, separate; flowers diœcious; woody vines. . . . . MENISPERMACEÆ 11
Pistil only one.
Ovary one-celled; anthers opening by uplifted valves. . . . . BERBERIDACEÆ 12
Ovary one-celled; anthers not opening by uplifted valves.
Style and stigma one; ovules more than one. PRIMULACEÆ 137
Style 1; stigmas 3; sepals 2; ovules several. PORTULACACEÆ 37

Ovary 2-4-celled.

Calyx-lobes minute or obsolete; petals valvate. . Vitaceæ 49

Calyx 4-5-cleft, valvate in the bud; petals involute. . . . . Rhamnaceæ 48

C. *Stamens not more than twice as many as the petals, when of just the number of the petals then alternate with them.*

1. *Calyx free from the ovary, i.e., the ovary wholly superior.*

* *Ovaries 2 or more, separate.*

Stamens united with each other, and with a large and thick stigma common to the two ovaries. . . . . Asclepiadaceæ 141

Stamens unconnected, on the receptacle, free from the calyx.

Leaves punctate with pellucid dots. . . . Rutaceæ 45

Leaves not pellucid-punctate.

Herbs, not fleshy. . . . . . . Ranunculaceæ 2

Herbs, with thick fleshy leaves. . . . Crassulaceæ 85

Stamens unconnected, inserted on the calyx.

Just twice as many as the pistils (flower symmetrical). . . . . Crassulaceæ 85

Not just the number or twice the number of the pistils.

Leaves without stipules. . . . . Saxifragaceæ 80

Leaves with stipules. . . . . . . Rosaceæ 66

* * *Ovaries 2-5, somewhat united at the base, separate above.*

Leaves punctate with pellucid dots. . . . . Rutaceæ 45

Leaves not pellucid-punctate.

Shrubs or trees with opposite leaves. . . . Sapindaceæ 51

Terrestrial herbs; the carpels fewer than the petals. . . . . Saxifragaceæ 80

* * * *Ovaries or lobes of ovary 3 to 5, with a common style.* . . . . Geraniaceæ 42

* * * * *Ovary only one, and*

† *Simple, with one parietal placenta.* Leguminosæ 56

† † *Compound, as shown by the number of cells, placentæ, styles, or stigmas.*

Ovary one-celled.

Corolla irregular; petals 4; stamens 6. . . Fumariaceæ 17

Corolla irregular; petals and stamens 5. . . Violaceæ 29

Corolla regular or nearly so.

Ovule solitary; shrubs or trees; stigmas 3. Anacardiaceæ 54

Ovules solitary or few; herbs. Some anomalous CRUCIFERÆ 20
Ovules more than one, in the centre or bottom of the cell.
Petals not inserted on the calyx. . CARYOPHYLLACEÆ 32
Ovules several or many, on two or more parietal placentæ.
Leaves punctate with pellucid and dark dots. HYPERICACEÆ 38
Leaves beset with reddish gland-tipped bristles. DROSERACEÆ 86
Leaves neither punctate nor bristly-glandular.
Sepals 5, very unequal or only 3. . . CISTACEÆ 28
Sepals and petals 4; stamens 6. Anomalous CRUCIFERÆ 20
Sepals and petals 5; stamens 5 or 10.
Ovary sessile. . . . . . . SAXIFRAGACEÆ 80

Ovary 2–several-celled.
Flowers irregular.
Anthers opening at the top,
Six or eight and 1-celled; ovary 2-celled, 2-ovuled.
. . . . POLYGALACEÆ 55
Ten and 2-celled; ovary 5-celled.
. . . . Rhododendron, in ERICACEÆ 133
Anthers opening lengthwise.
Stamens 5–8 or 10, and petals hypogynous, or nearly so.
Ovary 3-celled. . . . . . . SAPINDACEÆ 51
Ovary 5-celled. . . Impatiens, etc., in GERANIACEÆ 44
Flowers regular or nearly so.
Stamens neither just as many nor twice as many as the petals,
Triadelphous; petals 5. . . . . . HYPERICACEÆ 38
Tetradynamous (or rarely only 2 or 4); petals 4; pungent herbs. . . . . CRUCIFERÆ 20
Distinct and more numerous than the petals. SAPINDACEÆ 51
Stamens just as many or twice as many as the petals.
Ovules and seeds only 1 or 2 in each cell.
Herbs; flowers perfect and symmetrical.
Cells of the ovary as many as the sepals, etc.
. . . . GERANIACEÆ 42
Shrubs or trees.
Leaves palmately veined and fruit 2-winged, or pinnate and fruit a berry. . . . . SAPINDACEÆ 51
Leaves pinnately veined, simple, not punctate.
Calyx not minute; pod colored, dehiscent; seeds enclosed in a pulpy aril. . CELASTRACEÆ 47
Calyx minute; fruit a berry-like drupe. ILICINEÆ 46
Ovules (and usually seeds) several or many in each cell.

Stipules between the opposite and compound leaves (but they are caducous). . Staphylea, in SAPINDACEÆ 53

Stipules none when the leaves are opposite.

Stamens 10, monadelphous at the base. Leaflets 3, inversely heart-shaped. . Oxalis, in GERANIACEÆ 44

Stamens distinct, free from the calyx.

Style 1, undivided. . . . . . ERICACEÆ 127

Styles 2–5, separate. . . . . CARYOPHYLLACEÆ 32

Stamens distinct, inserted on the calyx.

Styles 2 (or 3), or splitting into 2 in fruit. SAXIFRAGACEÆ 80

2. *Calyx-tube adherent to the ovary, at least to its lower half.*

Tendril-bearing and often succulent herbs. . CUCURBITACEÆ 91

Not tendril-bearing.

Ovules and seeds more than one in each cell.

Ovary 1-celled, many-ovuled from the base. PORTULACACEÆ 37

Ovary 1-celled, with 2 or 3 parietal placentæ. SAXIFRAGACEÆ 80

Anthers not opening by pores.

Stamens on a flat disk which covers the ovary. . . . . CELASTRACEÆ 47

Stamens inserted on the calyx.

Eight or four (rarely five); style 1. . ONAGRACEÆ 88

Five or ten; styles 2–3, distinct. . SAXIFRAGACEÆ 80

Ovules and seeds only one in each cell.

Stamens 10 or 5 (instead of many),— . . . . . . rarely in Cratægus, in ROSACEÆ 79

Stamens 2 or 8; style 1; stigma 2–4-lobed; herbs. . . . . ONAGRACEÆ 88

Perfect stamens 4; styles 2; shrub. . HAMAMELIDEÆ 87

Stamens 4; style and stigma 1; chiefly shrubs. CORNACEÆ 100

Stamens 5; flowers in umbels, or rarely in heads.

Fruit dry, splitting in two at maturity; style 2. . . . . UMBELLIFERÆ 93

Fruit berry-like; styles 2–5, separate or united. . . . . ARALIACEÆ 98

DIVISION II. GAMOPETALÆ calyx and corolla both present; the latter with its petals united more or less into one piece.

A. *Stamens more numerous than the lobes of the corolla.*

Ovary 1-celled with one parietal placenta. . . LEGUMINOSÆ 56

Ovary 1-celled with two parietal placentæ. . . . . Adlumia, etc., in FUMARIACEÆ 18

Ovary 2-celled with a single ovule in each cell. . POLYGALACEÆ 55
Ovary 3-many-celled.
Stamens free or nearly free from the corolla ; style single. . . . . ERICACEÆ 127
Stamens free from the corolla ; styles 5. Oxalis, in GERANIACEÆ 44
Stamens inserted on the base or tube of the corolla.
Filaments monadelphous ; anthers 1-celled, kidney-shaped. . . . . MALVACEÆ 40
Filaments in pairs at each sinus ; anthers 1-celled. . . . . CAPRIFOLIACEÆ 101

B. *Stamens (fertile ones) as many as the lobes of the corolla and opposite them.*

Ovary 1-celled ; pod several-many-seeded ; style 1. PRIMULACEÆ 137

C. *Stamens as many as the lobes of the corolla and alternate with them, or fewer.*

1. *Ovary adherent to the calyx-tube (inferior).*

Tendril-bearing herbs ; anthers often united. . CUCURBITACEÆ 91
Tendrils none.
Stamens united by their anthers into a ring or tube.
Flowers in an involucrate head. . . . . COMPOSITÆ 108
Flowers separate, not involucrate ; corolla irregular. . . . . LOBELIACEÆ 125
Stamens separate, free from the corolla or nearly so, as many as its lobes ; stipules none ; juice milky. . CAMPANULACEÆ 126
Stamens separate, inserted on the corolla,
Four or five ; leaves opposite or whorled.
Ovary 2–5-celled.
Leaves whorled and without stipules. } RUBIACEÆ 105
Leaves opposite or whorled, and with stipules. }
Leaves opposite without stipules (petioles sometimes with stipule-like appendages). . . . CAPRIFOLIACEÆ 101

2. *Ovary free from the calyx (superior).*

* *Corolla irregular ; stamens (with anthers) 4 and didynamous, or only 2.*

Ovules and seeds solitary in the (1–4) cells.
Ovary 4-lobed, the style rising from between the lobes. LABIATÆ 164
Ovary not lobed, the style from its apex. . VERBENACEÆ 163
Ovules numerous or at least as many as 2 in each cell.

Ovary and pod 1-celled,
  With 2 or more parietal very many-seeded placentæ; stamens 4 . . . . OROBANCHACEÆ 161
Ovary and pod 2-celled; placentæ in the axis.
  Seeds rarely few, not on hooks, with albumen. . . . . SCROPHULARIACEÆ 154

*** Corolla somewhat irregular; stamens (with anthers) 5.*

Stamens free from the corolla; anthers with their cells opening by a hole or chink at the top. . Rhododendron, in ERICACEÆ 133
Stamens inserted on the corolla.
  Ovary not lobed; pod many-seeded.
    Filaments or some of them woolly. . . . . . . Verbascum, SCROPHULARIACEÆ 156

**** Corolla regular.*

† Stamens as many as the lobes of the corolla.

Ovaries 2, separate; their
  Stigmas and sometimes styles united into one.
    Filaments distinct; pollen in ordinary grains. APOCYNACEÆ 140
    Filaments monadelphous; pollen in masses. ASCLEPIADACEÆ 141
Ovary one, but deeply 4-lobed around the style.
  Leaves alternate. . . . . . . BORRAGINACEÆ 147
  Leaves opposite. . . . . . . Mentha, in LABIATÆ 166
Ovary one; not deeply lobed,
One-celled, one-ovuled, becoming an achene. . PLANTAGINACEÆ 171
One-celled, with ovules parietal or on 2 parietal placentæ.
  Leaves (or in Menyanthes three leaflets) entire. GENTIANACEÆ 143
  Leaves toothed, lobed, or pinnately compound. . . . . HYDROPHYLLACEÆ 146
Two to ten-celled.
  Leafless parasitic twining plants. Cuscuta, in CONVOLVULACEÆ 152
  Leaves when opposite without stipules.
    Stamens free from the corolla or nearly so; style 1. ERICACEÆ 127
    Stamens almost free from the corolla; style none. ILICINEÆ 46
    Stamens inserted on the tube of the corolla,
      Four; pod 2-celled, circumscissile. . PLANTAGINACEÆ 171
      Four; ovary 2–4-celled; ovules solitary. . VERBENACEÆ 163
      Five or rarely more.
        Fruit of two or four seed-like nutlets. . BORRAGINACEÆ 147
        Fruit a few-seeded pod.
          Sepals 5; styles 1 or 2, entire or 2-cleft; seeds large, only one or two in a cell. . CONVOLVULACEÆ 150

Fruit a many-seeded pod or berry.
Style single. . . . . . . SOLANACEÆ 152

† † *Stamens fewer than the lobes of the corolla.*

Stamens 4, didynamous.
Ovary 2–4-celled; the cells 1-seeded. . . VERBENACEÆ 163
Stamens only 2 with anthers; ovary 4-lobed.
. . . . Lycopus, in LABIATÆ 167
Stamens 2, rarely 3; ovary 2-celled.
Low herbs; corolla scarious, withering on the pod.
. . . . PLANTAGINACEÆ 171
Herbs; corolla rotate, or somewhat funnelform, and slightly irregular. . . . Veronica, in SCROPHULARIACEÆ 158

DIVISION III. APETALÆ: corolla (and sometimes calyx) wanting.

A. *Flowers not in catkins.*

1. *Ovary or its cells containing many ovules.*

Ovary and pod inferior (*i.e.*, calyx-tube adherent to the ovary),
Six-celled; stamens 6–12. . . . . ARISTOLOCHIACEÆ 174
One-celled, with parietal placentæ.
. . . . . . Chrysosplenium, in SAXIFRAGACEÆ 83
Ovary and pod wholly naked (there being no calyx),
Two-celled, 2-beaked; flowers capitate; tree. HAMAMELIDEÆ 87
Ovary and pod superior, *i.e.*, free from the calyx.
Two-celled or one-celled; placentæ central.
Stamens inserted on the receptacle or the base of the calyx,
Opposite the sepals when of the same number.
. . . . CARYOPHYLLACEÆ 32
One-celled, with one parietal placenta. }
Ovaries 2 or more, separate, simple. } . RANUNCULACEÆ 2

2. *Ovary or its cells containing only* 1 *or* 2, *rarely* 3 *or* 4, *ovules.*

* *Pistils more than one, and distinct or nearly so.*

Stamens inserted on the calyx; leaves with stipules. . ROSACEÆ 66
Stamens inserted on the receptacle.
Leaves punctate with pellucid dots. Xanthoxylum, in RUTACEÆ 46
Leaves not dotted.
Calyx present, and usually colored or petal-like.
. . . . RANUNCULACEÆ 2

* * *Pistil one, either simple or compound.*

Ovary partly inferior, the calyx coherent to its lower half, 2-celled; styles 2; stamens many. . . . . . HAMAMELIDEÆ 87

Ovary wholly inferior (in perfect or pistillate flowers).

Mostly woody plants; style or stigma one, entire; ovary 1-celled.

Stigma terminal, with or without a style.

Not parasitic above ground; anthers on filaments. . . . . SANTALACEÆ 175

Ovary really free from the calyx, but permanently invested by its tube, or the base of it, so as to seem inferior.

Herbs, with the calyx colored like a corolla.

Leaves alternate, pinnate. . . Poterium, in ROSACEÆ 76

Ovary plainly free from the calyx, which is sometimes wanting.

Stipules (ocreæ) sheathing the stem at the nodes.

Herbs; calyx present and commonly petal-like. POLYGONACEÆ 173

Stipules not sheathing the stem, or none.

Not aquatics, herbs.

Ovary 10-celled; berry 10-seeded. . . PHYTOLACCACEÆ 172

Shrubs or trees.

Ovules a pair in each cell of the ovary.

Fruit 2-celled, a double samara. Acerineæ, in SAPINDACEÆ 51

Ovules single in each cell of the

Three-celled ovary; leaves broad. . . RHAMNACEÆ 48

SUB-CLASS II. MONOCOTYLEDONS or ENDOGENS.

Stems without distinction of pith, wood and bark; leaves usually parallel veined; embryo with one cotyledon; flowers on the plan of three.

A. SPADICEOUS DIVISION. *Flowers aggregated on a spadix or fleshy axis, or sometimes scattered, destitute of calyx and corolla (excepting some* Araceæ *and* Naiadaceæ, *where, however, they are on a spadix), and also without glumes (husky scales). Leaves sometimes with netted veins.*

Terrestrial or marsh plants; leaves mostly with a distinct netted-veined blade, petioled. . . . . . . ARACEÆ 198

B. PETALOIDEOUS DIVISION. *Flowers not collected on a spadix, furnished with floral envelopes (perianth) answering to calyx or to both calyx and corolla, either herbaceous or colored and petal-like.*

1. *Perianth adherent to the whole surface of the ovary.*

Flowers perfect; ovules and seeds usually numerous.
Stamens only one or two; flower irregular, gynandrous. . . . . ORCHIDACEÆ 177
Stamens three.
Anthers extrorse, opening lengthwise. . . . IRIDACEÆ 189

2. *Perianth wholly free from the ovary.*

Pistil one, compound (cells or placentæ mostly 3).
Perianth not glumaceous or chaffy; flowers not in dense heads.
Stamens 6 (in Maianthemum 4), similar and perfect.
Terrestrial, not rush-like; seeds with albumen.
Perianth of similar divisions or lobes, mostly colored.
Perianth of 3 foliaceous and green sepals and 3 colored withering-persistent petals. . . . . . . Trillium in } LILIACEÆ 190

SIGNS COMMONLY USED.

° ′ ″ The sign of degrees (°) is used for feet, of minutes (′) for inches, of seconds (″) for lines—the line being the twelfth part of an inch, and very nearly equivalent to two millimetres.

μ In microscopic measurements, the conventional sign for the mikron or the one-thousandth part of a millimetre = one two-thousandth part of a line.

♂ Bearing only stamens or antheridia.

♀ Pistillate or bearing archegonia.

? A mark of doubt.

! A mark of affirmation or authentication.

Figures or words separated by a short dash (–) indicate the extremes of variation, as "5–10″ long, few–many-flowered," *i.e.*, varying from 5 to 10 lines in length, and with from few to many flowers.

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APPENDIX.

Branch I.—SPERMATOPHYTA.

Plants bearing flowers, with stamens and pistils, and producing seeds, which contain an embryo.

Class I. ANGIOSPERMÆ.

Pistil consisting of a closed ovary, which contains the ovules and forms the fruit. Cotyledons only two.

Sub-class I. DICOTYLEDONS or EXOGENS.

Stems formed of bark, wood, and pith; the wood forming a layer between the other two, increasing, when the stem continues from year to year, by the annual addition of a new layer to the outside, next the bark. Leaves netted-veined. Embryo with a pair of opposite cotyledons. Flowers having their parts usually in five or fours.

Division I. POLYPETALÆ.

Floral envelopes consisting of both calyx and corolla; the petals not united with each other. (Several genera or species belonging to Polypetalous Orders are destitute of petals, or have them more or less united.)

A. THALAMIFLORÆ. Stamens and petals hypogynous (free both from the calyx and from the superior ovary), upon a usually narrow receptacle (not glandular nor discoid, sometimes stipe-like). (Stamens and petals upon the partly inferior ovary in some Nymphæaceæ.) Apetalous flowers occur in the Ranunculaceæ and Caryophyllaceæ.

ORDER 1. RANUNCULACEÆ (CROWFOOT FAMILY).

Herbs or some woody plants, with a colorless and usually acrid juice, polypetalous, or apetalous with the calyx often colored like a corolla, hypogynous; the sepals, petals, numerous stamens, and many or few (rarely single) pistils all distinct and unconnected.—Flowers regular or irregular. Sepals 3–15. Petals 3–15, or wanting. Stamens indefinite, rarely few. Fruits either dry pods, or seed-like (achenes), or berries. Seeds anatropous (when solitary and suspended the rhaphe dorsal), with hard albumen and a minute embryo.—Leaves often dissected, their stalks dilated at the base, sometimes with stipule-like appendages. (A large family, including some acrid-narcotic poisons.)

Synopsis of the Genera.

Tribe I. CLEMATIDEÆ. Sepals normally 4, petal-like, valvate in the bud, or with the edges bent inward. Petals none, or small. Achenes numerous, tailed with the feathery or hairy styles. Seed suspended.—Leaves all opposite.

1. **Clematis.** Climbing by the leafstalks, or erect herbs.

Tribe II. ANEMONEÆ. Sepals 3–20, often petal-like, imbricated in the bud. Stamens mostly numerous. Achenes numerous or several, in a head or spike. Herbs, never climbing; leaves alternate or radical, the upper sometimes opposite or whorled.

* Petals none (rarely some staminodia). Seed suspended.

† All but the lower leaves opposite or whorled. Peduncles 1-flowered.

2. **Anemone.** Involucre leaf-like, remote from the flower. Leaves compound or dissected. Pistils very many.

3. **Hepatica.** Involucre close to the flower, of 3 oval bracts, calyx-like. Leaves radical, simple and lobed. Pistils several.

4. **Anemonella.** Stigma terminal, broad and flat. Radical leaves and involucre compound. Peduncles umbellate. Achenes 4–15, many-ribbed.

† † Leaves alternate, compound. Flowers panicled, often diœcious.

5. **Thalictrum.** Sepals usually 4, petal-like or greenish. Achenes few.

* * Petals evident. Sepals usually 5. Achenes many.

6. **Ranunculus.** Petals 5, yellow or white, with a scale or gland at base. Achenes capitate. Seed erect.

Tribe. III. HELLEBOREÆ. Sèpals imbricated in the bud, rarely persistent, petal-like. Petals often nectariferous or reduced to staminodia or none. Pods (follicles) or berries (in n. 10) few, rarely single, few–many-seeded.—Leaves alternate.

* Ovules and commonly seeds more than one pair. Herbs.

† Flowers regular, not racemose. Petals inconspicuous nectaries or slender or none. Sepals tardily deciduous.

7. **Caltha.** Petals none. Sepals broad, yellow. Leaves kidney-shaped, undivided.

8. **Coptis.** Petals 5–6, small, hollowed at apex, white. Pods long-stalked. Leaves radical, trifoliolate.

† † Sepals and large spur-shaped petals regular, each 5.

9. **Aquilegia.** Pistils 5, with slender styles. Leaves ternately compound.

† † † Flowers regular, racemose. Sepals caducous. Petals very small, stamen-like, or none. Leaves decompound.

10. **Actæa.** Flowers in a single short raceme. Pistil single, forming a many-seeded berry.

1. CLEMATIS, L. VIRGIN'S-BOWER.

Sepals 4, or rarely more, colored, the valvate margins turned inward in the bud. Petals none or small. Achenes numerous in a head, bearing the persistent styles as naked, hairy, or plumose tails.—Perennial herbs or vines, mostly a little woody, and climbing by the bending or clasping of the leaf-stalks, rarely low and erect. Leaves opposite. (Κληματις, a name of Dioscorides for a climbing plant with long and lithe branches.)

§ 1. FLAMMULA. *Flowers cymose-paniculate, rather small, in our species diœcious. Sepals petaloid, whitish, spreading, thin. Petals none. Anthers short, blunt.*

1. **C. Virginiana**, L. COMMON VIRGIN'S-BOWER. Smooth; leaves bearing 3 ovate acute leaflets, which are cut or lobed, and somewhat heart-shaped at the base; tails of the fruit plumose.—River-banks, etc., common, climbing over shrubs. July, August.

2. ANEMONE, Tourn. ANEMONE. WIND-FLOWER.

Sepals few or many, petal-like. Petals none. Achenes pointed or tailed, flattened, not ribbed. Seed suspended.—Perennial herbs with radical leaves; those of the stem 2 or 3 together, opposite or whorled, and forming an involucre remote from the flower; peduncles 1-flowered, solitary or umbellate. (The ancient Greek and Latin name, from ἀνεμόω, to be shaken by the wind.)

§ 1. ANEMONE proper. *Styles short, not plumose. Staminodia none.*

* *Achenes densely long-woolly, compressed; involucre far below the flower.*

† *Stems several; sepals 5–8; style filiform.*

1. **A. parviflora**, Michx. Stem 3–12′ high from a slender rootstock, 1-flowered; root-leaves 3-parted, their broadly wedge-shaped divisions crenate-incised or lobed; involucre 2–3-leaved; sepals 5

or 6, oval, white; head of fruit globular.—Newf. and Lab., Lake Superior, northward and westward. May, June.

† † *Taller, commonly branching above or producing two or more peduncles; involucral leaves long petioled; sepals 5–8, silky or downy beneath* (4–6″ *long*), *oval or oblong; style subulate.*

2. **A. Virginiana,** L. More loosely pubescent or glabrate; involucral leaves 3, 3-parted; their *divisions ovate-lanceolate,* pointed, cut-serrate, the lateral 2-parted, the middle 3-cleft; peduncles elongated, the earliest naked, the others with a 2-leaved involucel at the middle, repeatedly proliferous; *sepals* 5, *acute,* greenish (in one variety white and obtuse); *head of fruit oval or oblong.*—Woods and meadows; common. June–August.—Plant 2–3° high; the upright peduncles 6–12′ long.

** *Achenes rather few, nearly naked, ovate-oblong; stems slender, 1-flowered; leaves radical.*

3. **A. nemorosa,** L. Wind-flower. Wood A. Low, smoothish; stem perfectly simple, from a filiform rootstock; *involucre of* 3 *long-petioled trifoliolate* leaves, their leaflets wedge-shaped or oblong, and toothed or cut, or the lateral ones (var. quinquefolia) 2-parted; a similar radical leaf in sterile plants solitary from the rootstock; peduncle not longer than the involucre; sepals 4–7, oval, white, sometimes blue, or tinged with purple outside; carpels only 15–20, oblong, with a hooked beak.—Margin of woods. April, May.—A delicate vernal species; the flower 1′ broad. (Eu.)

3. HEPATICA, Dill. Liver-leaf. Hepatica.

Involucre simple and 3-leaved, very close to the flower, so as to resemble a calyx; otherwise as in Anemone.—Leaves all radical, heart-shaped and 3-lobed, thickish and persistent through the winter, the new ones appearing later than the flowers, which are single, on hairy scapes. (Name from a fancied resemblance to the liver in the shape of the leaves.)

1. **H. triloba,** Chaix. Leaves with 3 ovate obtuse or rounded lobes; those of the involucre also obtuse; sepals 6–12, blue, purplish, or nearly white; achenes several, in a small loose head, ovate-oblong, pointed, hairy.—Woods; common from the Atlantic to Mo.,

Minn., and northward; flowering soon after the snow leaves the ground in spring. (Eu.)

2. **H. acutiloba**, DC. Leaves with 3 ovate and pointed lobes, or sometimes 5-lobed; those of the involucre acute or acutish.—Passes into the other and has the same range.

4. ANEMONELLA, Spach.

Involucre compound, at the base of an umbel of flowers. Sepals 5–10, white and conspicuous. Petals none. Achenes 4–15, ovoid, terete, strongly 8–10 ribbed, sessile. Stigma terminal, broad and depressed.—Low glabrous perennial; leaves all radical, compound.

1. **A. thalictroides**, Spach. RUE-ANEMONE. Stem and slender petiole of radical leaf (a span high) rising from a cluster of thickened tuberous roots; leaves 2–3-ternately compound; leaflets roundish, somewhat 3-lobed at the end, cordate at the base, long-petiolulate, those of the 2–3-leaved 1–2-ternate involucre similar; flowers several in an umbel; sepals oval (½′ long, rarely pinkish), not early deciduous. (Thalictrum anemonoides, *Michx.*)—Woods, common, flowering in early spring with Anemone nemorosa, and considerably resembling it. Rarely the sepals are 3-lobed like the leaflets.

5. THALICTRUM, Tourn. MEADOW-RUE.

Sepals 4–5, petal-like or greenish, usually caducous. Petals none. Achenes 4–15, grooved or ribbed, or else inflated. Stigma unilateral. Seed suspended.—Perennials, with alternate 2–3-ternately compound leaves, the divisions and the leaflets stalked; petioles dilated at base. Flowers in corymbs or panicles, often polygamous or diœcious. (Derivation obscure.)

* *Flowers diœcious or sometimes polygamous, in ample panicles; filaments slender; stigmas elongated, linear or subulate; achenes sessile or short-stipitate, ovoid, pointed, strongly several-angled and grooved.*

1. **T. dioicum**, L. EARLY MEADOW-RUE. Smooth and pale or glaucous, 1–2° high; leaves (2–3) all with general petioles; leaflets drooping, rounded and 3–7 lobed; flowers purplish and greenish, diœcious; the yellowish anthers linear, mucronate, drooping on fine capillary filaments.—Rocky woods, etc.; common. April, May.

2. **T. polygamum**, Muhl. TALL M. Smooth, not glandular, 4–8° high; stem-leaves sessile; leaflets rather firm, roundish to oblong, commonly with mucronate lobes or tips, sometimes puberulent beneath; panicles very compound; flowers white, the fertile ones with some stamens; anthers not drooping, small, oblong, blunt, the mostly white filaments decidedly thickened upwards. (T. Cornuti, *Man.*, not *L.*)—Wet meadows and along rivulets, N.S. and Lab., to Ohio and southward; common. July–September.

3. **T. purpurascens**, L. PURPLISH M. Stem (2–4° high) usually purplish; stem-leaves sessile or nearly so; leaflets more veiny and reticulated beneath, with or without gland-tipped or glandless hairs or waxy atoms; panicles compound; flowers (sepals, filaments, etc.) greenish and purplish, diœcious; anthers linear or oblong-linear, mucronulate, dro ping on capillary filaments occasionally broadened at the summit.—Dry uplands and rocky hills, Q. and Ont., to Minn. and southward. May, June.

6. RANUNCULUS, Tourn. CROWFOOT. BUTTERCUP.

Sepals 5. Petals 5, flat, with a little pit or scale at the base inside. Achenes numerous, in a head, mostly flattened, pointed; the seed erect.—Annuals or perennials; stem-leaves alternate. Flowers solitary or somewhat corymbed, yellow, rarely white. (Sepals and petals rarely only 3, the latter often more than 5. Stamens occasionally few.)—(A Latin name for a little frog; applied by Pliny to these plants, the aquatic species growing where frogs abound.)

§ 1. BATRACHIUM. *Petals with a spot or naked pit at base, white, or only the claw yellow; achenes marginless, transversely wrinkled; aquatic or sub-aquatic perennials, with the immersed foliage repeatedly dissected (mostly by threes) into capillary divisions; peduncles 1-flowered, opposite the leaves.*

* *Receptacle hairy.*

1. **R. aquatilis**, L., var. **trichophyllus**, Gray. COMMON WHITE WATER-CROWFOOT. *Leaves* all under water and mostly *petioled*, their capillary divisions and subdivisions *rather long and soft, usually collapsing more or less when withdrawn from the water;* petiole rather narrowly dilated.—Common, especially in slow-

flowing waters, the eastern form with more soft and flaccid leaves. June–August. (Eu.)

§ 2. HALODES. *Petals yellow, with nectariferous pit and scale; carpels thin-walled, striate, in an oblong head; scapose, spreading by runners.*

2. **R. Cymbalaria**, Pursh. SEASIDE CROWFOOT. Glabrous; scapes 1–6′ high, 1–7 flowered; leaves clustered at the root and on the joints of the long rooting runners, roundish heart-shaped or kidney-shaped, crenate, rather fleshy, long-petioled; petals 5–8.—Sandy shores, from N. S. along the Great Lakes, and westward; also at salt springs. June–August.

§ 3. RANUNCULUS proper. *Petals with a little scale at the base, yellow; achenes nerveless.*

* *Achenes smooth; mostly perennial.*

† *Aquatic; immersed leaves filiformly dissected, as in* § Batrachium.

3. **R. multifidus**, Pursh. YELLOW WATER-CROWFOOT. Stems floating or immersed, with the leaves all repeatedly 3-forked into long filiform divisions, or sometimes creeping in the mud (perennial by rooting from the nodes, if at all); emersed leaves with shorter and linear or wedge-shaped divisions, or else kidney-shaped and sparingly lobed or toothed; petals 5–8, deep bright yellow, 4–6″ long, much larger than the calyx; carpels in a round head, pointed with a straight beak.—C. B., and westward. May–July.—Out of water it is often pubescent.

† † *Terrestrial but growing in very wet places, glabrous or nearly so; leaves entire or barely toothed, all or else all but the lowest lanceolate or linear; carpels forming a globular head.* (SPEARWORT.)

4. **R. Flammula**, L. SMALLER SPEARWORT. Stem reclining or ascending, rooting below, leaves lanceolate or linear, or the lowest ovate-oblong to lanceolate, entire or nearly so, mostly petioled (1–2′ long); petals 5–7, much longer than the calyx, bright yellow, *carpels small, flattish but turgid, mucronate with a short abrupt point.*—Only a small form (var. INTERMEDIUS) met with in this country (shore of L. Ontario, and northward), a span high, with flowers 3–5″ in diameter, passing into

Var. **reptans**, E. Meyer. Creeping S. Small, slender, the *filiform creeping stems rooting at all the joints;* leaves linear, spatulate, or oblong (½–1′ long); flowers small.—Gravelly or sandy banks; Newf. westward. June, Sept. (Eu.)

††† *Terrestrial, but often in wet places; leaves mostly cleft or divided.*

‡ *Root-leaves not divided to the very base; achenes marginless.*

5. **R. rhomboideus**, Goldie. Low (3–8′ high), *hairy; root-leaves roundish or rhombic-ovate,* rarely subcordate, toothed or crenate; lowest stem-leaves similar or 3–5-lobed, the upper 3–5-parted, almost sessile, the lobes linear; *carpels* orbicular *with a minute beak,* in a globose head; *petals large,* deep yellow.—Q. and Ont. westward and northward. April, May.

6. **R. abortivus**, L. Small-flowered C. Biennial, *glabrous,* branching, 6′–2° high; primary *root-leaves round heart-shaped or kidney-form,* barely crenate, the succeeding often 3-lobed or 3-parted; those of the stem and branches 3–5-parted or divided, subsessile, the divisions oblong or narrowly wedge-form, mostly toothed; head globose; *carpels mucronate, with a minute curved beak; petals pale yellow, shorter than the small reflexed calyx.*—Shady hillsides and along brooks, common. April–June.

Var. **micranthus**, Gray. *Pubescent,* roots often fusiform-thickened; root-leaves seldom at all heart-shaped, some 3-parted or 3-divided; peduncles more slender and carpels fewer.—Q. and westward.

7. **R. sceleratus**, L. Cursed C. Annual, glabrous; *root-leaves 3-lobed,* rounded; lower stem-leaves 3-parted, the lobes obtusely cut and toothed, the uppermost almost sessile, with the lobes oblong-linear and nearly entire; *carpels barely mucronulate,* very numerous, *in oblong or cylindrical heads; petals scarcely exceeding the calyx.*—Wet ditches; N.B., westward; appearing as if introduced. June–Aug.—Stem thick and hollow, 1° high; juice acrid and blistering; leaves thickish; flowers small, pale yellow. (Eu.)

‡‡ *Leaves variously cleft or divided; achenes in globular heads (except n. 10), compressed, with an evident firm margin; hirsute or pubescent.*

|| *Achenes with long recurved beak; root-leaves rarely divided.*

8. **R. recurvatus,** Poir. HOOKED C. Hirsute, 1–2° high; leaves of the root and stem nearly alike, long-petioled, deeply 3-cleft, large; the lobes broadly wedge-shaped, 2–3-cleft, cut and toothed towards the apex; petals shorter than the reflexed calyx, pale.—Woods, common. May, June.

|||| *Style subulate, stigmatose along the inner margin, mostly persistent.*

9. **R. repens,** L. Low, hairy or nearly glabrous; *stems ascending, or in wet ground, some of them forming long runners;* leaves 3-divided, the divisions all stalked, broadly wedge-shaped or ovate, unequally 3-cleft or parted and variously cut, never pinnately compound, frequently white-variegated or spotted. In low grounds; generally in waste grounds near the coast and probably introduced from Europe, but indigenous westward.

10. **R. Pennsylvanicus,** L. f. BRISTLY C. Stout and erect from a usually annual root, hirsute with widely-spreading bristly hairs, leafy to the top, 1–2° high; leaves all ternately divided or compound, the stalked leaflets unequally 3-cleft, sharply cut and toothed, acute; flowers inconspicuous; calyx reflexed; head of carpels oblong.—Wet places, common. June–Aug.

11. **R. bulbosus,** L. BULBOUS C. or BUTTERCUPS. Hairy; *stem erect from a bulb-like base,* 1° high; radical leaves 3-divided; *the lateral divisions sessile, the terminal stalked* and 3-parted, all wedge-shaped, cleft and toothed; peduncles furrowed; petals round, wedge-shaped at base; calyx reflexed; carpels tipped with a very short beak.—Fields; very abundant in E. New England; Ont. May–July.—Leaves appearing as if pinnate. Petals often 6 or 7, deep glossy yellow, the corolla more than an inch broad. (Nat. from Eu.)

12. **R. acris,** L. TALL C. or BUTTERCUPS. Hairy; stem erect (2–3° high); leaves 3-divided; *the divisions all sessile* and 3-cleft or parted, their segments cut into lanceolate or linear crowded lobes; peduncles not furrowed; petals obovate, much longer than the spreading calyx.—Fields; common, especially eastward. June–Aug.—Flower nearly as large as the last, but not so deep yellow.—The *Buttercups* are avoided by cattle, on account of their very acrid or even blistering juice, which property, however, is dissipated in drying when these plants are cut with hay. (Nat. from Eu.)

7. CALTHA, L. Marsh Marigold.

Sepals 5–9, petal-like. Petals none. Pistils 5–10, with scarcely any styles. Pods (follicles) compressed, spreading, many-seeded.—Glabrous perennials, with round and heart-shaped or kidney-form, large, undivided leaves. (An ancient Latin name for the common Marigold.)

1. **C. palustris,** L. Stem hollow, furrowed; leaves round or kidney-shaped, either crenate or dentate or nearly entire; sepals broadly oval (bright yellow).—Swamps and wet meadows, common. April, May.—Often called incorrectly *Cowslips;* used as a pot-herb in spring, when coming into flower.

8. COPTIS, Salisb. Goldthread.

Sepals 5–7, petal-like, deciduous. Petals 5–7, small, club-shaped, hollow at the apex. Stamens 15–25. Pistils 3–7, on slender stalks. Pods divergent, membranaceous, pointed with the style, 4–8-seeded.—Low, smooth perennials, with ternately divided root-leaves, and small white flowers on scapes. (Name from κόπτω, *to cut*, alluding to the divided leaves.)

1. **C. trifolia,** Salisb. Three-leaved Goldthread. Leaflets 3, obovate-wedge-form, sharply toothed, obscurely 3-lobed, scape 1-flowered.—Bogs, abundant northward, extending south to Maryland along the mountains, and west to Iowa. May.—Root of long, bright yellow, bitter fibres. Leaves evergreen, shining. Scape naked, slender, 3–5′ high. (Eu.)

9. AQUILEGIA, Tourn. Columbine.

Sepals 5, regular, colored like the petals. Petals 5, all alike, with a short spreading lip, produced backward into large hollow spurs, much longer than the calyx. Pistils 5, with slender styles. Pods erect, many-seeded.—Perennials, with 2–3-ternately compound leaves, the leaflets lobed. Flowers large and showy, terminating the branches. (Name from *aquilegus*, water-drawing.)

1. **A. Canadensis,** L. Wild Columbine. Spurs nearly straight, stamens and styles longer than the ovate sepals.—Rocks, common. April–June.– Flowers 2′ long, scarlet, yellow inside (or rarely all over), nodding, so that the spurs turn upward, but the stalk becomes upright in fruit.

10. ACTÆA, L. Baneberry. Cohosh.

Sepals 4 or 5, falling off when the flower expands. Petals 4–10, small, flat, spatulate, on slender claws. Stamens numerous, with slender white filaments. Pistil single; stigma sessile, depressed, 2-lobed. Fruit a many-seeded berry. Seeds smooth, flattened, and packed horizontally in 2 rows.—Perennials, with ample 2–3-ternately compound leaves, the ovate leaflets sharply cleft and toothed, and a short and thick terminal raceme of white flowers. (From ἀκτέα, *actæa*, ancient names of the elder, transferred by Linnæus.)

1. **A. spicata,** L., var. **rubra,** Ait. Red Baneberry. *Raceme ovate;* petals rhombic-spatulate, much shorter than the stamens; *pedicels slender; berries cherry-red,* or sometimes white, oval.—Rich woods, common, especially northward. April, May.—Plant 2° high. (Eu.)

2. **A. alba,** Bigel. White Baneberry. Leaflets more incised and sharply toothed; *raceme oblong; petals slender;* mostly truncate at the end, appearing to be transformed stamens; *pedicels thickened in fruit,* as large as the peduncle and red, the globular-oval *berries white.*—Rich woods, flowering a week or two later than the other, and more common westward and southward.—White berries rarely occur with slender pedicels, also red berries with thick pedicels; but these are perhaps the result of crossing.

Order 2. MENISPERMACEÆ (Moonseed Family).

Woody climbers, with palmate or peltate alternate leaves, no stipules, the sepals and petals similar, in three or more rows, imbricated in the bud; hypogynous, diœcious, 3–6-gynous; fruit a 1-seeded drupe, with a large or long curved embryo in scanty albumen.—Flowers small. Stamens several. Ovaries nearly straight, with the stigma at the apex, but often incurved in fruiting, so that the seed and embryo are bent into a crescent or ring.—Chiefly a tropical family.

* Sepals and petals present. Anthers 4-celled. Seed incurved.

1. **Menispermum.** Stamens 12–24, slender. Petals 6–8.

1. MENISPERMUM, L. Moonseed.

Sepals 4–8. Petals 6–8, short. Stamens 12–24 in the sterile flowers, as long as the sepals; anthers 4-celled. Pistils 2–4 in the

fertile flowers, raised on a short common receptacle; stigma broad and flat. Drupe globular, the mark of the stigma near the base, the ovary in its growth after flowering being strongly incurved, so that the (wrinkled and grooved) laterally flattened stone takes the form of a large crescent or ring. The slender embryo therefore is horseshoe-shaped; cotyledons filiform.—Flowers white, in small and loose axillary panicles. (Name from μήνη, *moon*, and σπέρμα, *seed.*)

1. **M. Canadense**, L. Leaves peltate near the edge, 3-7-angled or lobed.—Banks of streams; common. June, July.—Drupes black with a bloom, ripe in September, looking like frost grapes.

ORDER 3. BERBERIDACEÆ (BARBERRY FAMILY).

Shrubs or herbs, with the sepals and petals both imbricated in the bud, usuallg in two rows of 3 *(rarely* 2 *or* 4*) each; the hypogynous stamens as many as the petals and opposite to them; anthers opening by* 2 *valves or lids hinged at the top. Pistil single.* Filaments short. Style short or none. Fruit a berry or a pod. Seeds few or several, anatropous, with albumen. Embryo small, except in Berberis. Leaves alternate, with dilated bases or stipulate.

* Petals and stamens 6. Fruit few-seeded.

1. **Berberis.** Shrubs, with yellow flowers and wood; a pair of glandular spots on the base of each petal. Fruit a berry.
2. **Caulophyllum.** Herb, with greenish flowers; petals thick, much shorter than the sepals. Ovary soon bursting; the two seeds left naked.

1. BERBERIS, L. BARBERRY.

Sepals 6, roundish, with 2-6 bracelets outside. Petals 6, obovate, concave, with two glandular spots inside above the short claw. Stamens 6. Stigma circular, depressed. Fruit a 1-few-seeded berry. Seeds erect, with a crustaceous integument.—Shrubs, with yellow wood and inner bark, yellow flowers in drooping racemes, sour berries, and 1-9 foliolate leaves. Stamens irritable. (Derived from *Berberys*, the Arabic name of the fruit.)

B. vulgaris, L. COMMON BARBERRY. Leaves scattered on the fresh shoots of the season, mostly reduced to sharp triple or branched spines, from the axils of which the next season proceed rosettes or fascicles of obovate oblong closely bristly-toothed leaves

(the short petiole jointed!), and drooping *many-flowered racemes;* petals entire; *berries oblong,* scarlet.—Thickets and waste grounds in E. New Eng., where it has become thoroughly wild; N.B. to Ont. May, June. (Nat. from Eu.)

2. CAULOPHYLLUM, Michx. BLUE COHOSH.

Sepals 6, with 3 or 4 small bractlets at the base, ovate-oblong. Petals 6 thick and gland-like, somewhat kidney-shaped or hooded bodies, with short claws, much smaller than the sepals, one at the base of each of them. Stamens 6; anthers oblong. Pistil gibbous; style short; stigma minute and unilateral; ovary bursting soon after flowering by the pressure of the 2 erect, enlarging seeds, and withering away; the spherical seeds naked on their thick seed-stalks, looking like drupes, the fleshy integument turning blue; albumen horny.—A perennial glabrous herb, with matted knotty rootstocks, sending up in early spring a simple and naked stem, terminated by a small raceme or panicle of yellowish-green flowers, and a little below bearing a large triternately compound sessile leaf (whence the name, from καυλός, *stem,* and φύλλον, *leaf,* the stem seeming to form a stalk for the great leaf).

1. **C. thalictroides,** Michx. Also called PAPOOSE-ROOT. Stems 1–2½° high; leaflets obovate wedge-form, 2–3-lobed, a smaller biternate leaf often at the base of the panicle; flowers appearing while the leaf is yet small.—Deep rich woods; N. B. and Q.; common westward. April, May.—Whole plant glaucous when young, as also the seeds, which are as large as peas.

ORDER 4. NYMPHÆACEÆ (WATER-LILY FAMILY).

Aquatic perennial herbs, with horizontal rootstocks and peltate or sometimes only cordate leaves floating or emersed; the ovules borne on the sides or back (or when solitary hanging from the summit) of the cells, not on the ventral suture; the embryo enclosed in a little bag at the end of the albumen next the hilum, except in Nelumbium, which has no albumen. Radicle hardly any; cotyledons thick and fleshy, enclosing a well-developed plumule.—Flowers axillary, solitary. Vernation involute. Rootstocks apparently endogenous.—The few genera differ so much in the flower and fruit that they are separated into the three following sub-orders.

SUB-ORDER I. **Cabombeæ.** Sepals and petals each 3 or sometimes 4, hypogynous and persistent. Stamens definite (3–18). Pistils 2–18, free and distinct, coriaceous and indehiscent, 1–3-seeded on the dorsal suture.—Stems slender, leafy, coated with mucilage. Flowers small.

1. **Brasenia.** Stamens 12–18. Carpels 4–18. Leaves all peltate.

SUB-ORDER II. **Nymphæaceæ** proper. Sepals 4–6, and petals numerous in many rows, persistent or decaying away, either hypogynous or variously adnate to the surface of the compound 8–30-celled ovary, which is formed by the union of as many carpels ; the numerous ovules inserted over the whole inner face of the cells, except at the ventral suture. Stigmas radiate as in Poppy. Fruit baccate, with a firm rind. Petioles and peduncles from a thick rootstock.

2. **Nymphæa.** Petals adnate to the ovary, large ; the stamens on its summit.
3. **Nuphar.** Petals (very small and stamen-like) and stamens inserted under the ovary.

1. BRASENIA, Schreber. WATER-SHIELD.

Sepals 3 or 4. Petals 3 or 4, linear, sessile. Stamens 12–18 ; filaments filiform ; anthers innate. Pistils 4–18, forming little club-shaped indehiscent pods ; stigmas linear. Seeds 1–2, pendulous on the dorsal suture !—Rootstock creeping. Leaves alternate, long-petioled, centrally peltate, oval, floating. Flowers axillary, small, dull-purple. (Name of uncertain origin.)

1. **B. peltata,** Pursh. Leaves entire, 1–4′ across.—Ponds and slow streams. June–Aug. (Asia, Africa and Australia).

2. NYMPHÆA, Tourn. WATER-NYMPH. WATER-LILY.

Sepals 4, green outside, nearly free. Petals numerous, in many rows, the innermost gradually passing into stamens, imbricately inserted all over the ovary. Stamens indefinite, inserted on the ovary, the outer with dilated filaments. Ovary 12–35-celled, the concave summit tipped with a globular projection at the centre, around which are the radiate stigmas ; these project at the margin, and are extended into linear and incurved sterile appendages. Fruit depressed-globular, covered with the bases of the decayed petals, maturing under water. Seeds enveloped by a sac-like aril.—Flowers

white, pink, yellow, or blue, very showy. (Dedicated by the Greeks to the Water-Nymphs.)

1. **N. odorata**, Ait. SWEET-SCENTED WATER-LILY. *Rootstock with few and persistent branches;* leaves orbicular, cordate-cleft at the base to the petiole (5–9′ wide), the margin entire; stipules broadly triangular or almost kidney-shaped, notched at the apex, appressed to the rootstock; *flower* white, *very sweet scented* (often as much as 5½′ in diameter when fully expanded, opening early in the morning, closing in the afternoon); petals obtuse; anthers blunt; aril much longer than the distinctly stipitate *oblong seeds* (these about 1½″ long).—Ponds and still or slow-flowing water; common. June–Sept.

3. NUPHAR, Smith. YELLOW POND-LILY. SPATTER-DOCK.

Sepals 5, 6, or sometimes more, colored, or partly green outside, roundish, concave. Petals numerous, small and thickish, stamen-like or scale-like, inserted with the very numerous short stamens on the receptacle under the ovary, not surpassing the disk-like 8–24-rayed sessile stigma, persistent and at length recurved. Fruit ovoid, naked, usually ripening above water. Aril none.—Rootstock creeping, cylindrical. Leaves with a deep sinus at the base. Flowers yellow or sometimes tinged with purple, produced all summer. (Name said to be of Arabic origin.)

1. **N. advena**, Ait. f. *Sepals* 6, *unequal; petals shorter than the stamens* and resembling them, thick and fleshy, truncate; stigma nearly entire, 12–24-rayed, pale red; ovary and fruit (1½′ long) ovate, not contracted above into a narrow neck; thin submersed leaves seldom present; floating or emersed and erect leaves thick (6–12′ long), from roundish to ovate or almost oblong, the sinus open, or closed or narrow.—Very common, in still or stagnant water; stout and coarse; flower often partly purplish (var. VARIEGATUM, Engelm.).

2. **N. Kalmianum**, Ait. Very slender and with slender rootstock; submersed leaves thin, round-reniform, the floating broadly elliptical with a deep narrow sinus, 2–4′ long; sepals usually 5, the flowers an inch broad or less; petals spatulate or obovate; stigmas 7–10-rayed, dark red; fruit globular with a short neck (6–9″ in

diameter). (N. luteum, var. pumilum, *Man.*)—Maine and Newf., to Penn. and Minn., and northward.

ORDER 5. **SARRACENIACEÆ** (PITCHER-PLANTS).

Polyandrous and hypogynous bog-plants, with hollow pitcher-form or trumpet-shaped leaves,—comprising one plant in the mountains of Guiana, another (Darlingtonia, *Torr.*) in California, and the following genus in the Atlantic United States.

1. **SARRACENIA**, Tourn. SIDE-SADDLE FLOWER.

Sepals 5, with 3 bractlets at the base, colored, persistent. Petals 5, oblong or obovate, incurved, deciduous. Stamens numerous, hypogynous. Ovary compound, 5-celled, globose, crowned with a short style, which is expanded at the summit into a very broad and petal-like, 5-angled, 5-rayed, umbrella-shaped body; the 5 delicate rays terminating under the angles in as many little hooked stigmas. Capsule with a granular surface, 5-celled, with many-seeded placentæ in the axis, loculicidally 5-valved. Seeds anatropous, with a small embryo at the base of fleshy albumen.—Perennials, yellowish-green and purplish; the hollow leaves all radical, with a wing on one side, and a rounded arching hood at the apex. Scape naked, 1-flowered; flower nodding. (Named by Tournefort in honor of *Dr. Sarrasin* of Quebec, who first sent our Northern species, and a botanical account of it, to Europe.)

1. **S. purpurea,** L. SIDE-SADDLE FLOWER. PITCHER-PLANT. HUNTSMAN'S CUP. *Leaves pitcher-shaped*, ascending, curved, broadly winged; the hood erect, open, round heart-shaped; *flower deep purple;* the fiddle-shaped petals arched over the greenish-yellow style.—Varies rarely with greenish-yellow flowers, and without purple veins in the foliage.—Peat-bogs; common from N. Eng. and Lab. to Minn., N.-E. Iowa, and southward east of the Alleghanies. June.—The curious leaves are usually half filled with water and drowned insects. The inner face of the hood is clothed with stiff bristles pointing downward. Flower globose, nodding on a scape a foot high; it is difficult to fancy any resemblance between its shape and a side-saddle, but it is not very unlike a pillion.

ORDER 6. **PAPAVERACEÆ** (POPPY FAMILY).

Herbs with milky or colored juice, regular flowers with the parts in twos or fours, fugacious sepals, polyandrous, hypogynous, the ovary

1-celled with two or more parietal placentæ.—Sepals 2, rarely 3, falling when the flower expands. Petals 4–12, spreading, imbricated and often crumpled in the bud, early deciduous. Stamens rarely as few as 16, distinct. Fruit a dry 1-celled pod. Seeds numerous, anatropous, often crested, with a minute embryo at the base of fleshy and oily albumen.—Leaves alternate, without stipules. Peduncles mostly 1-flowered. Juice narcotic or acrid.

* Petals 8–12, not crumpled in the bud, white. Pod 1-celled, 2-valved.

1. **Sanguinaria.** Petals white. Leaves and 1-flowered scape from a short rootstock.

* * Petals 4, crumpled in the bud. Pod 2-valved or more.

† Pod 2–4-valved, the valves separating to the base from the placentas. Leaves pinnately parted. Flowers yellow.

2. **Chelidonium.** Pod linear, smooth; style almost none; stigmas and placentas 2.

1. SANGUINARIA, Dill. Blood-root.

Sepals 2. Petals 8–12, spatulate-oblong, the inner narrower. Stamens about 24. Style short; stigma 2-grooved. Pod oblong, turgid, 1-celled, 2-valved. Seeds with a large crest.—A low perennial, with thick prostrate premorse rootstocks, surcharged with red-orange acrid juice, sending up in earliest spring a rounded palmate-lobed leaf, and a 1-flowered naked scape. Flower white, handsome, the bud erect, the petals not crumpled. (Name from the color of the juice.)

1. **S. Canadensis,** L. Open rich woods; common. April, May.

2. CHELIDONIUM, L. Celandine.

Sepals 2. Petals 4. Stamens 16–24. Style nearly none; stigma 2-lobed. Pod linear, slender, smooth, 2-valved, the valves opening from the bottom upward. Seeds crested.—Biennial herb with brittle stems, saffron-colored acrid juice, pinnately divided or 2-pinnatifid and toothed or cut leaves, and small yellow flowers in a pedunculate umbel; buds nodding. (Ancient Greek name from χελιδών, the *swallow*, because its flowers appear with the swallows.)

1. **C. majus,** L. Celandine. Waste grounds near dwellings. N.B. to Ont. May–Aug. (Adv. from Eu.)

Order 7. FUMARIACEÆ (Fumitory Family).

Delicate smooth herbs, with watery juice, compound dissected leaves, irregular flowers, with 4 somewhat united petals, 6 diadelphous

stamens, and 2-merous pods and seeds like those of the Poppy Family. —Sepals 2, small and scale-like. Corolla flattened, closed; the 4 petals in two pairs; the outer with spreading tips, and one or both of them spurred or saccate at the base; inner pair narrower, and their callous crested tips united over the stigma. Stamens in two sets of 3 each, placed opposite the larger petals, hypogynous; their filaments often united; middle anther of each set 2-celled, the lateral ones 1-celled. Pod 1-celled, either 1-seeded and indehiscent, or several-seeded with 2 parietal placentæ and deciduous valves. — Leaves delicate, usually alternate, without stipules. Slightly bitter, innocent plants.

* Corolla bigibbous or 2-spurred, the 2 outer petals alike. Pod several-seeded.

1. **Adlumia.** Petals united into a spongy persistent subcordate corolla. Seeds crestless.
2. **Dicentra.** Corolla cordate or 2-spurred at base, less united. Seeds crested.

* * Corolla with but one petal spurred at base, deciduous.

3. **Corydalis.** Pod with few to many crested or arilled seeds.
4. **Fumaria.** Fruit a globular 1-seeded nutlet. Seed crestless.

1. ADLUMIA, Raf. Climbing Fumitory.

Petals all permanently united in a cordate-ovate corolla, becoming spongy-cellular and persistent, enclosing the small, few-seeded pod. Seeds not crested. Stigma 2-crested. Filaments monadelphous below in a tube which is adherent to the corolla, diadelphous at the summit.—A climbing biennial, with thrice-pinnate leaves, cut-lobed delicate leaflets, and ample panicles of drooping white or purplish flowers. (Dedicated by Rafinesque to *Major Adlum.*)

1. **A. cirrhosa**, Raf. Wet woods; N.B. to Wisc., E. Kan., and southward.—June–Oct.—A handsome vine, with delicate foliage, climbing by the slender young leaf-stalks over high bushes; often cultivated.

2. DICENTRA, Borkh. Dutchman's Breeches.

Petals slightly cohering into a heart-shaped or 2-spurred corolla, either deciduous or withering-persistent. Stigma 2-crested and sometimes 2-horned. Filaments slightly united in two sets. Pod 10–20-seeded. Seeds crested.—Low, stemless perennials (as to our wild species) with ternately compound and dissected leaves, and racemose nodding flowers. Pedicels 2-bracted. (Name from δίς,

twice, and *κέντρον, a spur;*—accidentally printed DICLYTRA in the first instance, which by an erroneous conjecture was afterwards changed into DIELYTRA.)

* *Raceme simple, few-flowered.*

1. **D. Cucullaria**, DC. DUTCHMAN'S BREECHES. Scape and slender-petioled leaves from a sort of *granulate bulb;* lobes of leaves linear; *corolla with 2 divergent spurs* longer than the pedicel; *crest of the inner petals minute.*—Rich woods, N.S. to Ont., especially westward.—A very delicate plant, sending up in early spring, from the cluster of grain-like tubers crowded together in the form of a scaly bulb, the finely cut leaves and the slender scape, bearing 4–10 pretty, but odd, white flowers tipped with cream color.

2. **D. Canadensis**, DC. SQUIRREL CORN. Subterranean shoots bearing scattered *grain-like tubers* (resembling peas or grains of Indian corn, yellow); leaves as in n. 1; *corolla merely heart-shaped,* the spurs very short and rounded; *crest of the inner petals conspicuous, projecting.*—Rich woods, N.S. to Ont. April, May.—Flowers greenish-white tinged with rose, with the fragrance of Hyacinths.

3. CORYDALIS, Vent.

Corolla 1-spurred at the base (on the upper side), deciduous. Style persistent. Pod many-seeded. Seeds crested or arilled. Flowers in racemes. Our species are biennial, leafy-stemmed, and pale or glaucous. (The ancient Greek name for the crested lark.)

* *Stem strict; flowers purplish or rose-color with yellow tips.*

1. **C. glauca**, Pursh. PALE CORYDALIS. Racemes panicled; spur of the corolla very short and rounded; pods erect, slender, elongated.—Rocky places; common; 6′–2° high. May–Aug.

** *Low, ascending; flowers yellow.*

† *Outer petals merely carinate on the back, not crested.*

3. **C. aurea**, Willd. GOLDEN C. Corolla golden-yellow, ½′ long, the slightly decurved spur about half as long, shorter than the pedicel; pods spreading or pendulous, becoming torulose; seeds obtuse-margined.—Rocky banks, Q. and westward.

4. FUMARIA, Tourn. FUMITORY.

Corolla 1-spurred at the base. Style deciduous. Fruit indehiscent, small, globular, 1-seeded. Seeds crestless.—Branched and

leafy-stemmed annuals, with finely dissected compound leaves, and small flowers in dense racemes or spikes. (Name from *fumus*, smoke.)

1. **F. officinalis**, L. COMMON FUMITORY. Sepals ovate-lanceolate, acute, sharply toothed, narrower and shorter than the corolla (which is flesh-color tipped with crimson); fruit slightly notched.—Waste places, about dwellings, Q. and Ont. (Adv. from Eu.)

ORDER 8. CRUCIFERÆ (MUSTARD FAMILY).

Herbs, with a pungent watery juice and cruciform tetradynamous flowers; fruit a silique or silicle.—Sepals 4, deciduous. Petals 4, hypogynous, regular, placed opposite each other in pairs, their spreading limbs forming a cross. Stamens 6, two of them inserted lower down and shorter (rarely only 4 or 2). Pod usually 2-celled by a thin partition stretched between the two marginal placentæ, from which when ripe the valves separate, either much longer than broad (a *silique*), or short (a *silicle*), sometimes indehiscent and nut-like (*nucumentaceous*), or separating across into 1-seeded joints (*lomentaceous*). Seeds campylotropous, without albumen, filled by the large embryo, which is curved or folded in various ways: *i.e.*, the *cotyledons accumbent*, viz., their margins on one side applied to the radicle, so that the cross-section of the seed appears thus o=; or else *incumbent*, viz., the back of one cotyledon applied to the radicle, thus o||. In these cases the cotyledons are plane; but they may be folded upon themselves and round the radicle, as in Mustard, where they are *conduplicate*, thus o>>. Leaves alternate, no stipules. Flowers in terminal racemes or corymbs; pedicels rarely bracted.—A large and very natural family, of pungent or acrid, but not poisonous plants. (The characters of the genera are taken almost wholly from the pods and seeds; the flowers being nearly alike in all.)

SERIES I. Pod 2-celled, regularly dehiscent by 2 valves.

* Pod compressed parallel to the broad partition. Seeds flat or flattish, orbicular or oval; cotyledons accumbent or nearly so.

† Pod linear; valves nerveless. Seeds in one row.

1. **Dentaria**. Stem naked below, 2-3-leaved. Pod coriaceous, with thick placentas, long-styled. Seeds wingless; cotyledons thick, very unequal.
2. **Cardamine**. Stem leafy. Pod coriaceous, with thick placentas. Seeds wingless; cotyledons flattened, equal.

†† Pod linear, or oblong, or orbicular; valves 1-nerved or nerveless. Seeds in 2 rows (except in species of n. 3).

3. **Arabis.** Pod long-linear, the flat or flattish valves more or less 1-nerved. Seeds winged or wingless. Flowers white to purple. Stems leafy, at least below

4. **Draba.** Pod oval to narrowly oblong or lanceolate; valves flat or flattish, faintly nerved or veined. Seeds wingless, numerous.

** Pod terete or turgid, or 4-angled by the prominent midnerves. Seeds wingless, more or less turgid.

† Pod linear (or oblong or even globular in n. 5).

‡ Cotyledons accumbent.

5. **Nasturtium.** Pod often short; valves strongly convex, nerveless. Seeds small, in 2 rows in each cell. Flowers yellow or white.

6. **Barbarea.** Pod somewhat 4-sided; valves strongly 1-nerved. Seeds in 1 row. Flowers yellow.

‡‡ Cotyledons incumbent or partially so.

7. **Erysimum.** Pod 4-sided; valves strongly 1-nerved; stigma broadly 2-lobed. Pubescence of appressed 2–3-parted hairs. Flowers yellow.

‡‡‡ Cotyledons conduplicate.

8. **Brassica.** Pod beaked or pointed beyond the end of the valves, or tipped with a rigid style, nearly terete, or 4-sided. Flowers yellow or whitish.

*** Pod short; the boat-shaped valves conduplicate or much flattened contrary to the narrow partition. Flowers white.

9. **Capsella.** Pod many-seeded, obcordate-triangular, wingless. Cotyledons incumbent.

10. **Lepidium.** Pod 2-seeded, flat, scale-shaped. Cotyledons incumbent or accumbent.

SERIES II. Pods indehiscent, continuous or transversely jointed; joints 1-celled.

11. **Cakile.** Pod short, 2-jointed; joints 1-seeded. Cotyledons plane, accumbent.

12. **Raphanus.** Pod elongated, several-seeded, continuous, or constricted between the seeds and moniliform. Cotyledons conduplicate.

1. DENTARIA, Tourn. TOOTHWORT. PEPPER-ROOT.

Pod lanceolate, flat, as in Cardamine. Style elongated. Seeds in one row, wingless, the stalks broad and flat. Cotyledons petioled, thick and very unequal, their margins somewhat infolding each other.—Perennials, of damp woodlands, with long, horizontal, fleshy, sometimes interrupted, scaly or toothed rootstocks, of a pleasant pungent taste; the simple stems leafless below, bearing 2 or 3 petioled compound leaves about or above the middle, and terminated by a single corymb or short raceme of large white or

purple flowers. Flowers larger, pods broader, and seeds larger than is usual in Cardamine. (Name from *dens*, a tooth.)

* *Rootstock elongated; leaves 3-foliolate.*

1. **D. diphylla,** L. Rootstock long and continuous, often branched, toothed; stem-leaves 2, similar to the radical ones, close together; leaflets rhombic-ovate or oblong-ovate, shortly petiolate, coarsely crenate, the teeth abruptly acute; petals white.—Rich woods, Maine to Q. and Ont. May.—Rootstocks 5–10′ long, crisp, tasting like Water-Cress.

2. CARDAMINE, Tourn. Bitter Cress.

Pod linear, flattened, usually opening elastically from the base; the valves nerveless and veinless, or nearly so; placentas and partitions thick. Seeds in a single row in each cell, wingless; their stalks slender. Cotyledons accumbent, flattened, equal or nearly so, petiolate.—Mostly glabrous perennials, leafy-stemmed, growing along watercourses and in wet places. Flowers white or purple. (A Greek name, in Dioscorides, for some cress, from its cordial or cardiacal qualities.)

* *Root perennial; leaves simple.*

1. **C. rhomboidea,** DC. Spring Cress. *Stems upright from a tuberous base and slender rootstock bearing small tubers, simple;* root-leaves round and often heart-shaped; lower stem-leaves ovate or rhombic-oblong, somewhat petioled, the upper almost lanceolate, sessile, all often sparingly toothed; pods linear-lanceolate, pointed with a slender style tipped with a conspicuous stigma; *seeds round-oval.*—Wet meadows and springs; common. April–June.—Flowers large, white.

Var. **purpurea,** Torr. Lower (4–6′ high), and usually slightly pubescent; flowers rose-purple, appearing earlier.—Along streams in rich soil. N. S. and Ont.

* * *Root mostly biennial or annual; leaves pinnate; flowers small, white.*

2. **C. hirsuta,** L. Small Bitter Cress. Glabrous or beset with scattered hairs; stems (3′–2° high) erect or ascending from the spreading cluster of root-leaves; their leaflets rounded, those of the upper leaves oblong or linear and often confluent, all either toothed,

angled, or entire; pods linear, very narrow, erect or ascending; style variable.—Wet places; common. May–July.

3. ARABIS, L. Rock Cress.

Pod linear, flattened; placentas not thickened; the valves plane or convex, more or less 1-nerved in the middle, or longitudinally veiny. Seeds usually margined or winged. Cotyledons accumbent or a little oblique.—Leaves seldom divided. Flowers white or purple. (Name from the country, *Arabia*. See *Linn. Phil. Bot.* § 235.)

§ 1. ARABIS proper. *Seeds in one row in each cell, orbicular or nearly so, more or less wing-margined; cotyledons strictly accumbent.*

* *Erect and simple leafy-stemmed biennials, with simple leaves, white or whitish flowers, narrow but flattened ascending or erect pods, and nearly wingless seeds.*

1. **A. hirsuta,** Scop. Rough-hairy, sometimes smoothish, strictly erect (1–2° high); stem-leaves oblong or lanceolate, entire or toothed, partly clasping by a somewhat arrow-shaped or heart-shaped base; petals (greenish-white) small, but longer than the calyx; *pedicels and pods strictly upright; style scarcely any;* immature seeds somewhat 2-rowed.—Rocks, common, N. B. westward. May, June. (Eu.)

** *Erect and simple leafy-stemmed biennials (1–3° high), with small whitish flowers, recurved-spreading or pendulous flat pods (3–4′ long), and broadly winged seeds, their stalks adherent to the partition; root-leaves rarely lyrate.*

2. **A. lævigata,** Poir. *Smooth* and glaucous, upright; *stem-leaves partly clasping* by the arrow-shaped base, lanceolate or linear, sparingly cut-toothed or entire; petals scarcely longer than the calyx; *pods long and narrow, recurved-spreading* on ascending or merely spreading pedicels.—Rocky places, Maine and Q. to Ont. May.

§ 2. PSEUDARABIS. *Seeds oblong or elliptical, very small, wingless, in one row; cotyledons often more or less oblique. Biennial or perennial, branching from the base.*

3. **A. lyrata**, L. Mostly glabrous, except the *lyrate-pinnatifid root-leaves;* stem-leaves scattered, spatulate or linear with a tapering base, sparingly toothed or entire; *petals white*, much longer than the yellowish calyx; pods long and slender, flat, ascending or spreading.—On rocks or sandy shores, Q. and Ont. to Minn., and northward. April–July.—Usually biennial, but southward in the mountains decidedly perennial.

4. DRABA, Dill. WHITLOW GRASS.

Pod oval, oblong, or even linear, flat; the valves plane or slightly convex; the partition broad. Seeds several or numerous, in 2 rows in each cell, marginless. Cotyledons accumbent. Filaments not toothed.—Low herbs with entire or toothed leaves, and white or yellow flowers; pubescence often stellate. (Name from δράβη, applied by Dioscorides to some cress; meaning unknown.)

§ 1. DRABÆA. *Petals not notched or cleft; perennial or biennial, leafy-stemmed; flowers white; pods twisted when ripe.*

1. **D. incana**, L. *Hoary-pubescent*, biennial or somewhat perennial, the radical tuft seldom branching; leaves oblanceolate or the cauline lanceolate to ovate, few-toothed or entire; *pods oblong to lanceolate, usually acute and straight, often pubescent*, on short erect pedicels; style very short or none.—Dry rocks, Anticosti and N.B., and far westward. (Eu.)

Var. **arabisans**, Watson. Caudex much branched; pod glabrous, acuminate or acute, twisted, beaked with a longer distinct style. (D. arabisans, *Michx.*)—Anticosti and Lake Nipigon.

5. NASTURTIUM, R. Br. WATER CRESS.

Pod a short silique or a silicle, varying from oblong-linear to globular, terete or nearly so; valves strongly convex, nerveless. Seeds usually numerous, small, turgid, marginless, in 2 irregular rows in each cell (except in N. sylvestre). Cotyledons accumbent. —Aquatic or marsh plants, with yellow or white flowers, and commonly pinnate or pinnatifid leaves, usually glabrous. (Name from *Nasus tortus*, a convulsed nose, alluding to the effect of its pungent qualities.)

§ 1. *Petals white, twice the length of the calyx; pods linear; leaves pinnate.*

1. **N. officinale**, R. Br. TRUE WATER CRESS. Perennial; stems spreading and rooting; leaflets 3–11, roundish or oblong, nearly entire; pods (6–8″ long) ascending on slender widely spreading pedicels.—Brooks and ditches; escaped from cultivation. N.S. to Ont. (Nat. from Eu.)

§ 2. *Petals yellow or yellowish, seldom much exceeding the calyx; pods linear, oblong, or even ovoid or globular; leaves mostly pinnatifid.*

* *Annual or biennial, rarely perennial (?), with simple fibrous roots; flowers small or minute, greenish or yellowish; leaves somewhat lyrate.*

2. **N. palustre**, DC. MARSH CRESS. Stem erect; *leaves pinnately cleft or parted*, or the upper laciniate; the lobes oblong, cut-toothed; *pedicels about as long as the small flowers and mostly longer than* the oblong, ellipsoid, or ovoid *pods*; style short.—Wet places or in shallow water; common. June–Sept.—Flowers only 1–1½″ long. Stems 1–3° high.—The typical form with oblong pods is rare. Short pods and hirsute stems and leaves are common.

6. BARBAREA, R. Br. WINTER CRESS.

Pod linear, terete or somewhat 4-sided, the valves being keeled by a mid-nerve. Seeds in a single row in each cell, marginless. Cotyledons accumbent.—Mostly biennials, resembling Nasturtium; flowers yellow. (Anciently called the Herb of St. Barbara.)

1. **B. vulgaris**, R. Br. COMMON WINTER CRESS. YELLOW ROCKET. Smooth; lower leaves lyrate, the terminal division round and usually large, the lateral 1–4 pairs or rarely wanting; upper leaves obovate, cut-toothed, or pinnatifid at the base; pods erect or slightly spreading; or in var. STRICTA, appressed; in var. ARCUATA, ascending on spreading pedicels.—Low grounds and roadsides; apparently introduced, but indigenous from N.S. to Ont. northward and westward. (Eu.)

7. ERYSIMUM, Tourn. TREACLE MUSTARD.

Pod linear, 4-sided, the valves keeled with a strong midrib; stigma broadly lobed. Seeds in 1 row in each cell, oblong, marginless. Cotyledons (often obliquely) incumbent.—Chiefly biennials, with

yellow flowers; the leaves not clasping. Pubescence of appressed 2–3-parted hairs. (Name from ἐρύω, *to draw blisters.*)

1. **E. cheiranthoides,** L. WORM-SEED MUSTARD. Minutely roughish, branching, slender; leaves lanceolate, scarcely toothed; flowers small; *pods small and short* (7–12″ long), very obtusely angled, ascending on slender *divergent pedicels.*—Banks of streams, July. (Eu.)

8. BRASSICA, Tourn. BRASSICA AND SINAPIS.

Pod linear or oblong, nearly terete or 4-sided, with a stout 1-seeded beak or a rigid style; valves 1–5-nerved. Seeds globose, 1-rowed. Cotyledons incumbent, folded around the radicle.—Annuals or biennials, with yellow flowers. Lower leaves mostly lyrate, incised, or pinnatifid. (The Latin name of the Cabbage. Sinapis is the Greek σίναπι, which is said to come from the Celtic *nap*, a turnip.)

1. **B. Sinapistrum,** Boiss., or SINAPIS ARVENSIS, L., the English CHARLOCK, with knotty pods, fully one-third occupied by a stout 2-edged beak (which is either empty or 1-seeded), the upper leaves barely toothed, is a noxious weed in grain fields, from N. B. to Ont. (Adv. from Eu.)

2. **B.** (or SINAPIS) **alba,** Boiss. WHITE MUSTARD. Pods bristly, ascending on spreading pedicels, more than half its length occupied by the sword-shaped 1-seeded beak; leaves all pinnatifid; seeds pale. N. B. to Ont. (Cult. and adv. from Eu.)

3. **B.** (or SINAPIS) **nigra,** Koch. BLACK MUSTARD. Pods smooth (½′ long), 4-cornered (the valves only 1-nerved), erect on appressed pedicels forming a slender raceme, tipped with a stout persistent style; seeds dark brown, smaller and more pungent than in the last; lower leaves with a large terminal lobe and a few small lateral ones.—Fields and waste places, N. S. to Ont. (Adv. from Eu.)

4. **B. campestris,** L., in the form of the RUTABAGA and the TURNIP, sometimes persists a year or two in neglected grounds.

9. CAPSELLA, Medic. SHEPHERD'S PURSE.

Pod obcordate-triangular, flattened contrary to the narrow partition; the valves boat-shaped, wingless. Seeds numerous.

Cotyledons incumbent.—Annuals; flowers small, white. (Name a diminutive of *capsa*, a box.)

1. **C. Bursa-pastoris,** Moench. Root-leaves clustered, pinnatifid or toothed; stem-leaves arrow-shaped, sessile.—Waste places; the commonest of weeds. April–Sept. (Nat. from Eu.)

10. LEPIDIUM, Tourn. PEPPERWORT. PEPPERGRASS.

Pod roundish, much flattened contrary to the narrow partition; the valves boat-shaped and keeled. Seeds solitary in each cell, pendulous. Cotyledons incumbent, or in n. 1 accumbent! Flowers small, white or greenish. (Name from λεπίδιον, *a little scale*, alluding to the small flat pods.)—Ours are annuals or biennials.

* *Leaves all with a tapering base, the upper linear or lanceolate and entire, the lower and often the middle ones incised or pinnatifid; pods orbicular or oval, with a small notch at the top; the style minute or none; stamens only* 2.

1. **L. Virginicum,** L. WILD PEPPERGRASS. *Cotyledons accumbent* and seed minutely margined; *pod marginless* or obscurely margined at the top; petals present, except in some of the later flowers.—June–Sept. A common roadside weed, Q. and Ont., which has immigrated from farther south.

2. **L. intermedium,** Gray. *Cotyledons incumbent; pod minutely wing-margined at the top;* petals usually minute or wanting; otherwise nearly as in n. 1.—Dry places, from western N.S. to B.C.

11. CAKILE, Tourn. SEA-ROCKET.

Pod short, 2-jointed across, fleshy, the upper joint separating at maturity; each indehiscent, 1-celled and 1-seeded, or the lower sometimes seedless. Seed erect in the upper, suspended in the lower joint. Cotyledons obliquely accumbent.—Seaside fleshy annuals. Flowers purplish. (An old Arabic name.)

1. **C. Americana,** Nutt. AMERICAN SEA-ROCKET. Leaves obovate, sinuate and toothed; lower joint of the fruit obovoid, emarginate; the upper ovate, flattish at the apex. N. S. to Ont. July–Sept.—Joints nearly even and fleshy when fresh; the upper one 4-angled and appearing more beaked when dry.

12. RAPHANUS, Tourn. Radish.

Pods linear or oblong, tapering upward, indehiscent, several-seeded, continuous and spongy within between the seeds, or necklace-form by constriction between the seeds, with no proper partition. Style long. Seeds spherical and cotyledons conduplicate, as in Brassica.—Annuals or biennials. (The ancient Greek name from ῥᾳ, *quickly*, and φαίνω, *to appear*, alluding to the rapid germination.)

1. **R. raphanistrum**, L. Wild Radish. Jointed Charlock. Pods necklace-form, long-beaked; leaves lyre-shaped, rough; petals yellow, turning whitish or purplish, veiny.—A troublesome weed in fields, N.S. to Ont. (Adv. from Eu.)

Order 9. CISTACEÆ (Rock-Rose Family).

Low shrubs or herbs, with regular flowers, distinct and hypogynous mostly indefinite stamens, a persistent calyx, a 1-celled 3–5-valved capsule with as many parietal placentæ borne on the middle of the valves, and orthotropous albuminous seeds.—Sepals 5; the two external much smaller, bract-like, or sometimes wanting; the three others a little twisted in the bud. Petals 3 or 5, convolute in the opposite direction from the calyx in the bud. Anthers short, innate, on slender filaments. Style single or none. Ovules few or many, on slender stalks, with the orifice at the apex. Embryo long and slender, straightish or curved, in mealy albumen; cotyledons narrow.—Leaves simple and mostly entire, the lower usually opposite, and the upper alternate. Inert plants.

1. **Helianthemum.** Petals 5, crumpled in the bud, fugacious (or none). Stigma nearly sessile. Stamens and ovules numerous in the petal-bearing flowers.
2. **Hudsonia.** Petals 5, fugacious. Stamens 9–30. Style long and slender. Pod strictly 1-celled, 2–6-seeded. Heath-like.

1. HELIANTHEMUM, Tourn. Rock-Rose.

Petals 5, crumpled in the bud, fugacious. Styles short or none in our species; stigma 3-lobed. Capsule strictly 1-celled. Embryo curved in the form of a hook or ring.—Flowers in most N. American species of two sorts, viz., *primary* or earlier ones, with large petals, indefinitely numerous stamens and many-seeded pods; and *secondary*, or later ones, which are much smaller and in clusters, with small petals or none, 3–10 stamens, and much smaller 3–few-seeded

pods. The yellow flowers open only once, in sunshine, and cast their petals by the next day. (Name from ἥλιος, *the sun*, and ἄνθεμον, *flower*.)

1. **H. Canadense**, Michx. Frost-weed. *Petal-bearing flowers solitary; the small secondary flowers clustered in the axils of the leaves,* nearly sessile; calyx of the large flowers hairy-pubescent, of the small ones hoary, like the stem and lower side of the lanceolate-oblong leaves.—Sandy or gravelly dry soil, Maine and Ont. June–Aug.—Stems at first simple. Corolla of the large flowers 1′ wide, producing pods 3″ long; pods of the smaller flowers not larger than a pin's head.

2. HUDSONIA, L.

Petals 5, fugacious (lasting but a day), much larger than the calyx. Stamens 9–30. Style long and slender; stigma minute. Pod oblong, enclosed in the calyx, strictly 1-celled, with 1 or 2 seeds attached near the base of each nerve-like placenta. Embryo coiled into the form of a closed hook.—Bushy heath-like little shrubs (seldom a foot high), covered all over with the small awl-shaped or scale-like alternate persistent downy leaves, producing numerous (small but showy) bright yellow flowers crowded along the upper part of the branches. (Named in honor of *Wm. Hudson*, an early English botanist.)

1. **H. tomentosa**, Nutt. Hoary with down; leaves oval or narrowly oblong, 1″ long, close-pressed and imbricated; flowers sessile or some short peduncled.—Sandy shores, N.S., and along the Great Lakes to Minn. and westward; rarely on banks of streams inland. May, June.

Order 10. VIOLACEÆ (Violet Family).

Herbs, with a somewhat irregular 1-spurred corolla of 5 petals, 5 hypogynous stamens with adnate introrse anthers conniving over the pistil, and a 1-celled 3-valved pod with 3 parietal placentæ.—Sepals 5, persistent. Petals imbricated in the bud. Stamens with their short and broad filaments continued beyond the anther-cells, and often coherent with each other. Style usually club-shaped, with the simple stigma turned to one side. Valves of the capsule bearing the several-seeded placentæ on their middle; after opening, each valve as it dries folds together lengthwise firmly, projecting

the seeds. Seeds anatropous, rather large, with a hard seed-coat, and a large and straight embryo nearly as long as the albumen; cotyledons flat.—Leaves alternate, with stipules. Flowers axillary, nodding. (Roots slightly acrid or emetic.)

1. **Viola.** Sepals auricled. Lower petal spurred. Stamens distinct, the 2 lower spurred.

1. VIOLA, Tourn. VIOLET. HEART'S-EASE.

Sepals extended into ears at the base. Petals somewhat unequal, the lower one spurred at the base. Stamens closely surrounding the ovary, often slightly cohering with each other; the two lower bearing spurs which project into the spur of the corolla. Besides these conspicuous blossoms, which appear in spring, others are produced later (especially in the stemless species), on shorter peduncles or on runners, usually concealed under the leaves; these never open nor develop petals, but are fertilized in the bud, and are far more fruitful than the ordinary blossoms. (The ancient Latin name of the genus.)

§ 1. *Perennials; stipules never leaf-like, the lower more or less scarious.*

* *Stemless, the leaves and scapes directly from a rootstock or from runners.*

† *Stigma small, naked, often beaked or pointed.*

‡ *Rootstock fleshy and thickened, never filiform nor producing runners; flowers violet or purple (rarely white); lateral petals bearded.*

1. **V. palmata**, L. COMMON BLUE V. Glabrous to villous-pubescent; early leaves roundish-cordate or reniform and merely crenate, the sides rolled inward when young, the latter very various, palmately or pedately or hastately lobed or parted, the segments obovate to linear. (V. cucullata, var. palmata, *Gray*.)—Moist or dryish, especially sterile, ground; very common.

Var. **cucullata** (Gray). Later leaves merely crenate, not lobed, (V. cucullata, *Ait.*)—Low grounds; common everywhere. Both forms are very variable in the size and shape of the leaves and sepals, and in the size and color of the flowers, which are deep or pale violet-blue or purple, sometimes white or variegated with white.

‡ ‡ *Rootstocks long and filiform, extensively creeping.*

|| *Flowers blue or purple.*

2. **V. Selkirkii**, Pursh. GREAT-SPURRED V. Small and delicate; the filiform rootstock fibrose-rooted, no runners above ground; smooth, except the round-heart-shaped crenate leaves, which are minutely hairy on the upper surface and have a deep narrowed sinus; *spur very large*, thickened at the end, almost as long as the beardless pale violet petals.—Damp and shady soil, N.B. to Ont. and northward; rare.—Scapes and petioles 1–2′, the leaf $\frac{1}{2}$–$1\frac{1}{4}$′ long, thin; the spur 3″ long. (Eu.)

||||*Flowers white (small, short-spurred), mostly with brown-purple veins; lateral petals bearded or beardless. Species apparently confluent.*

3. **V. blanda**, Willd. SWEET WHITE V. Commonly glabrous; leaves round-heart-shaped or kidney-form; petals mostly beardless, the lower strongly veined.—Damp places, everywhere. Flowers faintly sweet-scented.

|||||*Flowers yellow.*

4. **V. rotundifolia**, Michx. ROUND-LEAVED VIOLET. Leaves round-ovate, heart-shaped, slightly crenate; lateral petals bearded and marked with brown lines; spur very short.—Cold woods, N.S. and Q.—Smoothish; leaves 1′ broad at flowering, increasing to 3 or 4′ in the summer, then lying flat on the ground, shining above.

** *Leafy-stemmed; all perennial with short rootstocks.*

† *Stems erect, without root-leaves; stipules entire; spur very short; stigma beakless, pubescent.*

‡ *Stems naked below; flowers yellow.*

5. **V. pubescens**, Ait. DOWNY YELLOW V. Softly pubescent (6–12′ high); *leaves very broadly heart-shaped*, toothed, somewhat pointed; stipules ovate or ovate-lanceolate, large; lower petals veined with purple, capsule oblong to globular, glabrous or tomentose.—Woods; common.

‡‡ *Stems more leafy and prolonged; flowers white or purplish.*

6. **V. Canadensis**, L. CANADA V. Upright (1–2° high); leaves heart-shaped, pointed, serrate; stipules ovate-lanceolate, entire; petals white or whitish inside, the upper ones mostly tinged with violet beneath, the lateral bearded.—Rich woods; common northward and along the Alleghanies. May–Aug.

† † *Stems erect or spreading (at first nearly acaulescent); stipules fringe-toothed; spur oblong to cylindrical; stigma naked.*

7. **V. canina**, L., var. **Muhlenbergii**, Gray. Dog V. Low (3–8′ high), mostly glabrous; stems ascending, mostly simple, from the base at length producing creeping branches; leaves heart-shaped, or the lowest kidney-form, crenate, the uppermost slightly pointed; stipules lanceolate; *spur cylindrical, half the length of the light violet petals*, the lateral ones slightly bearded; stigma beaked. —Damp or wet shady places; common. May–July. (Eu.)

Order 11. CARYOPHYLLACEÆ (Pink Family).

Herbs, with opposite entire leaves, symmetrical 4–5-merous flowers, with or without petals; the distinct stamens no more than twice the number of the sepals, either hypogynous or perigynous; styles 2–5 (or rarely united into one); seeds several or usually many, attached to the base or to the central column of the 1-celled (rarely 3–5-celled) pod, with a slender embryo coiled or curved around the outside of mealy albumen, in Dianthus nearly straight.—Bland herbs; the stems usually swollen at the joints; uppermost leaves rarely alternate. Leaves often united at the base. Calyx persistent. Styles stigmatic along the inside. Seeds amphitropous or campylotropous.

Tribe I. SILENEÆ. Sepals united into a tube or cup. Petals (mostly convolute in the bud) and stamens (10) borne on the stipe or stock of the ovary, the former with slender claws, to the base of which the corresponding filaments often adhere, included in the calyx-tube. Seeds numerous.—Stipules none. Flowers often large and showy.

* Calyx naked. Seeds globular or kidney-shaped; embryo curved or coiled.

1. **Silene.** Calyx 5-toothed, 10-nerved. Styles 3.
2. **Lychnis.** Calyx 5-toothed, 10-nerved. Styles 5, rarely 4.

Tribe II. ALSINEÆ. Sepals distinct or nearly so, imbricated in the bud. Petals when present without claws, mostly imbricated, and with the stamens inserted at the base of the sessile ovary, or into a little disk. Pod splitting into valves or teeth, several-many-seeded. Stamens opposite the sepals, when not more in number.—Low herbs.

* Stipules none.

† Styles opposite the sepals, or, when fewer, opposite those which are exterior in the bud.

‡ Pod short, splitting into as many valves as styles; valves often bifid or 2-parted.

3. **Arenaria.** Petals entire. Styles usually 3. Valves of the pod entire, bifid, or 2-parted.
4. **Stellaria.** Petals 2-cleft or none. Styles usually 3. Valves bifid or 2-parted.

‡‡ Pod cylindrical, dehiscent by twice as many teeth as styles.

5. **Cerastium.** Petals notched or 2-cleft. Styles 5 or 4. Seeds fixed edgewise.

** Stipules present. Pod short.

6. **Buda.** Styles 3. Pod 3-valved. Leaves opposite.

1. SILENE, L. Catchfly. Campion.

Calyx 5-toothed, 10–many-nerved, naked at the base. Stamens 10. Styles 3, rarely 4. Pod 1-celled, sometimes 3-celled at least at the base, opening by 3 or 6 teeth at the apex.—Flowers solitary or in cymes. Petals mostly crowned with a scale at the base of the blade. (Name from σίαλον, *saliva*, from the viscid exudation on the stems and calyx of many species. The English name *Catchfly* alludes to the same peculiarity.)

* *Calyx not inflated, except by the enlarging pod; annuals.*

† *Glabrous, a portion of each joint of the stem glutinous; flowers pink.*

1. **S. antirrhina,** L. Sleepy C. Stem slender (8–30′ high); *leaves lanceolate or linear;* flowers small, paniculate; *calyx ovoid;* petals obcordate, crowned, opening transiently in sunshine.—Dry soil; common in waste places. Ottawa and westward. June–Sept.

†† *Viscid-pubescent; flowers white or nearly so, opening at night, sweet-scented.*

2. **S. noctiflora,** L. Night-flowering C. *Viscid-hairy,* tall (1–3° high); lower leaves large and spatulate, the upper lanceolate; *flowers few, peduncled;* calyx-tube elongated (over 1′ long), soon ovoid, with awl-shaped teeth; petals rather large, 2-parted, crowned.—Cultivated grounds. N.B. and westward.

2. LYCHNIS, Tourn. Cockle.

Styles 5, rarely 4, and pod opening by as many or twice as many teeth; otherwise nearly as in Silene. Calyx in one species with leaf-like lobes. (Ancient Greek name for a scarlet or flame-colored species, from λύχνος, *a light* or *lamp.*)

1. **L. Githago,** Lam. Corn Cockle. Annual, clothed with long soft appressed hairs; flowers long-peduncled; *calyx-lobes similar to the long and linear leaves,* surpassing the broad and crownless *purple-red petals,* falling off in fruit. (Agrostemma Githago, *L.*)—In wheat fields. (Adv. from Eu.)

2. **L. Flos-cuculi**, L. Ragged Robin. Perennial, erect, slightly downy below, viscid above; leaves narrowly lanceolate; flowers in loose panicles; calyx short, glabrous; petals red, 4-lobed, lobes linear.—Moist or marshy places; N.B., New Eng. and N.Y. (Adv. from Eu.)

3. ARENARIA, L. Sandwort.

Sepals 5. Petals 5, entire, sometimes barely notched, rarely wanting. Stamens 10. Styles 3, rarely more or fewer, opposite as many sepals. Pod short, splitting into as many or twice as many valves as there are styles, few–many-seeded.—Low, usually tufted herbs, with sessile exstipulate leaves and small white flowers. (Name from *arena*, sand, in which many of the species grow.)—The following sections are by many botanists taken for genera.

§ 1. ARENARIA proper. *Pod splitting wholly or part-way down into 3 or at length into 6 valves; seeds many, naked at the hilum.*

1. **A. serpyllifolia**, L. Thyme-leaved Sandwort. Diffusely branched, roughish (2–6′ high); leaves ovate, acute, small; cymes leafy; sepals lanceolate, pointed, 3–5-nerved, about equalling the petals and 6-toothed pod.—A low annual; sandy waste places. N.S. to Ont. June–Aug. (Nat. from Eu.)

§ 2. ALSINE. *Pod splitting to the base into 3 entire valves; seeds many, usually rough, naked at the hilum; flowers solitary and terminal or cymose; root in our species perennial.*

* *Leaves small, rigid, awl-shaped or bristle-shaped.*

2. **A. verna**, L. Dwarf, alpine, densely matted, glabrous or (var. hirta) somewhat pubescent, 1–3′ high; leaves narrowly linear or awl-shaped; flowers loosely cymose; sepals lanceolate, pointed, 3-nerved, shorter than the pod. Lab. to B.C. (Eu.)

* * *Leaves soft and herbaceous, filiform-linear; petals retuse or notched.*

3. **A. Grœnlandica**, Spreng. Mountain S. Densely tufted from slender roots, smooth; flowering stems filiform, erect (2–4′ high), few-flowered; *sepals oblong, obtuse, nerveless.*—Summit of the Shawangunk, Catskill, and Adirondack Mountains, N.Y., of the higher mountains of New Eng., and northward; alpine or sub-

alpine. June–Aug.—Leaves and peduncles 3–6″ long; flowers large in proportion.

§ 3. MŒHRINGIA. *Parts of the flower sometimes in fours; pod as in § 1, but the young ovary 3-celled; seeds rather few, smooth, with a thickish appendage (strophiole) at the hilum; perennials, with flaccid broadish leaves.*

4. **A. lateriflora**, L. Sparingly branched, erect, minutely pubescent; leaves oval or oblong, obtuse (½–1′ long); peduncles 2- (rarely 3–4) flowered, soon becoming lateral; sepals oblong, obtuse.—Gravelly shores, etc., N.S. to B.C. May, June. (Eu.)

4. STELLARIA, L. CHICKWEED. STARWORT.

Sepals 4–5. Petals 4–5, deeply 2-cleft, sometimes none. Stamens 8, 10, or fewer. Styles 3, rarely 4 or 5, opposite as many sepals. Pod ovoid, 1-celled, opening by twice as many valves as there are styles, several–many-seeded. Seeds naked.—Flowers (white) solitary or cymose, terminal, or appearing lateral by the prolongation of the stem from the upper axils. (Name from *stella*, a star, in allusion to the star-shaped flowers.)

* *Stems spreading, flaccid, marked longitudinally with one or two pubescent lines; leaves ovate or oblong, ½–2½′ long.*

1. **S. media**, Smith. COMMON CHICKWEED. Annual or nearly so; *lower leaves on hairy petioles; petals shorter than the calyx*, 2-parted, stamens 3–10.—Everywhere in damp grounds. (Nat. from Eu.)

* * *Stems erect or spreading; wholly glabrous perennials, with sessile and narrow or small leaves; stamens usually* 10, *perigynous.*

† *Scaly-bracted; petals 2-parted, equalling or surpassing the calyx.*

2. **S. longifolia**, Muhl. LONG-LEAVED STITCHWORT. Stem erect, weak, often with rough angles (8–18′ high); *leaves linear, acutish at both ends, spreading; cymes naked and at length lateral, peduncled*, many-flowered, the slender *pedicels spreading;* petals 2-parted, longer than the calyx; seeds smooth.—Grassy places; common, especially northward. June, July. (Eu.)

3. **S. longipes**, Goldie. LONG-STALKED S. Shining or somewhat glaucous, very smooth; *leaves ascending, lanceolate or linear-lanceolate*, acute, *broadest at the base*, rather rigid; cyme terminal,

few-flowered, the long *pedicels strictly erect;* petals longer than the calyx; seeds smooth.—N. S. to B. C. (Eu.)

4. **S. uliginosa,** Murr. SWAMP S. Stems weak, decumbent or diffuse, at length prolonged, leaving the naked and usually *sessile cymes lateral; leaves lanceolate or oblong,* veiny; petals and ripe *pods as long as the calyx; seeds roughened.*—Swamps and rills, N. S., westward. (Eu.)

5. CERASTIUM, L. MOUSE-EAR CHICKWEED.

Sepals 5, rarely 4. Petals as many, 2-lobed or cleft, rarely entire. Stamens twice as many, or fewer. Styles equal in number to the sepals and opposite them. Pod 1-celled, usually elongated, membranaceous, opening at the apex by twice as many teeth as there were styles, many-seeded. Seeds rough.—Flowers white, in terminal cymes. Our species have the petals 2-cleft or obcordate, the parts of the flower always in fives, and the exserted pods more or less curved. (Name from *κέρας, a horn,* alluding to the shape of the pod in many species.)

1. **C. viscosum,** L. MOUSE-EAR CHICKWEED. *Annual,* hairy and rather clammy, nearly erect (4–9′ high); *leaves ovate or obovate to oblong spatulate;* bracts herbaceous; *flowers small* in close clusters at first, *pedicels even in fruit not longer than the acute sepals; petals shorter than the calyx.* (C. vulgatum, *L. Herb.,* and *Man.*) Grassy places, N. S. to B. C. May–July.—Stamens often 5. (Nat. from Eu.)

2. **C. vulgatum,** L. LARGER M. Perennial; stems clammy-hairy, spreading (6–15′ long); *leaves oblong;* upper bracts scarious-margined; *flowers larger* (sepals 2–3″ long), at first clustered, the fruiting *pedicels* longer, the earlier ones mostly much *longer than the obtuse sepals;* petals equalling the calyx. (C. viscosum, *L. Herb.,* and *Man.* C. triviale, *Link.*)—Fields and copses; N. B. and Ont., perhaps indigenous. May–July. (Nat. from Eu.)

3. **C. arvense,** L. FIELD CHICKWEED. Perennial; stems ascending or erect, tufted, downy or nearly smooth, slender (4–8′ high), naked and *few–several-flowered* at the summit; *leaves linear or narrowly lanceolate;* petals obcordate, more than twice the length of the calyx; *pods scarcely longer than the calyx.*—Dry or rocky places, Lab., westward. May–July. (Eu.)

6. BUDA, Adans. SAND-SPURREY.

Sepals 5. Petals 5, entire. Stamens 2–10. Styles and valves of the many-seeded pod 3, very rarely 5, when the valves alternate with the sepals! Embryo not coiled into a complete ring.—Low herbs, mostly on or near the sea-coast, with filiform or linear somewhat fleshy opposite leaves, and smaller ones often clustered in the axils; stipules scaly-membranaceous; flowering all summer. (Named probably for the city so called.)—Genus also known as TISSA, Adans., SPERGULARIA, Presl., and LEPIGONUM, Wahlb.

1. **B. rubra,** Dumort. Nearly glabrous, the summit of the prostrate or ascending slender stems, peduncles, and sepals usually glandular-pubescent; leaves linear, flat, scarcely fleshy; stipules lanceolate, entire or cleft; pedicels longer than the bracts; *pods and pink-red corolla small* ($1\frac{1}{2}''$), *hardly equalling or exceeding the calyx; seeds rough with projecting points, semi-obovate* or *gibbous-wedge-shaped, wingless.* (Spergularia rubra, *Presl.*)—Dry sandy soil, near the coast, but rarely maritime. N.S., N.B. and Q. (Eu.)

2. **B. marina,** Dumort. More decidedly fleshy than the preceding, erect or ascending, usually pubescent, with ovate stipules, terete leaves, and pedicels 2–4″ long; sepals usually becoming $2\text{–}2\frac{1}{2}''$ long, little shorter than the pod; petals pale; *seeds obovate-rounded and roughened with points,* wingless or narrow-winged. (Spergularia salina, *Presl.* Tissa marina, *Britt.*)—Brackish sands, etc., coast of Lab., N.S., N.B. and Q., and southward. (Eu.)

ORDER 12. PORTULACACEÆ (PURSLANE FAMILY).

Herbs, with succulent leaves, and regular but unsymmetrical flowers, viz., *sepals fewer than the petals; the stamens opposite the petals when of the same number, but often indefinite; otherwise nearly as* Chickweeds.—Sepals 2. Petals 5, or sometimes none. Stamens mostly 5–20. Styles 2–8, united below, or distinct, stigmatic along the inside. Pod 1-celled, with few or many campylotropous seeds rising on stalks from the base. Embryo curved around mealy albumen.—Insipid and innocent herbs, with entire leaves. Corolla opening only in sunshine, mostly ephemeral, then shrivelling.

1. **Portulaca.** Stamens 7–20, on the partly adherent calyx. Pod opening by a lid.
2. **Claytonia.** Stamens as many as the hypogynous petals, and attached to their base. Calyx persistent. Pod 3–6-seeded.

1. PORTULACA, Tourn. PURSLANE.

Calyx 2-cleft; the tube cohering with the ovary below. Petals 5, rarely 6, inserted on the calyx with the 7–20 stamens, fugacious. Style mostly 3–8 parted. Pod 1-celled, globular, many-seeded, opening transversely, the upper part (with the upper part of the calyx) separating as a lid.—Fleshy annuals, with mostly scattered leaves. (An old Latin name, of unknown meaning.)

1. **P. oleracea,** L. COMMON PURSLANE. Prostrate, very smooth; leaves obovate or wedge-form; flowers sessile (opening only in sunny mornings); sepals keeled; petals pale yellow; stamens 7–12; style deeply 5–6-parted; flower-bud flat and acute.—Cultivated and waste grounds; common. Seemingly indigenous west and southwestward. (Nat. from Eu.)

2. CLAYTONIA, Gronov. SPRING-BEAUTY.

Sepals 2, ovate, free, persistent. Stamens 5, adhering to the short claws of the petals. Style 3-cleft at the apex. Pod 1-celled, 3-valved, 3–6-seeded.—Our two species are perennials, sending up simple stems in early spring from a small deep tuber, bearing a pair of opposite leaves, and a loose raceme of pretty flowers. Corolla rose-color with deeper veins, opening for more than one day! (Named in honor of *Dr. John Clayton*, one of our earliest botanists, who contributed to Gronovius the materials for the Flora Virginica.)

1. **C. Virginica,** L. Leaves linear-lanceolate, elongated (3–6′ long).—Moist open woods; common, N.S., westward and southward.

2. **C. Caroliniana,** Michx. Flowers rather smaller and fewer; leaves spatulate-oblong or oval-lanceolate (1–2′ long).—N.S., Q. and E. Ont., and southward along the Alleghanies.

ORDER 13. HYPERICACEÆ (ST. JOHN'S-WORT FAMILY).

Herbs or shrubs, with opposite entire dotted leaves and no stipules, regular hypogynous flowers, the petals mostly oblique and convolute in the bud, and many or few stamens commonly collected in 3 or more clusters or bundles. Pod 1-celled with 2–5 parietal placentæ, and as many styles, or 3–7-celled by the union of the placentæ in the centre; dehiscence mostly septicidal.—Sepals 4 or 5, imbricated in the bud,

herbaceous, persistent. Petals 4 or 5, mostly deciduous. Styles persistent, at first sometimes united. Seeds numerous, small, anatropous, with no albumen. Embryo cylindrical.—Plants with a resinous juice, dotted with pellucid or dark glands, usually smooth. Leaves mostly sessile. Flowers solitary or cymose.

* Petals oblique, convolute, yellow; hypogynous glands none.

1. **Hypericum.** Sepals 5, alike. Petals 5. Stamens usually many and in 3 or 5 clusters.

1. HYPERICUM, Tourn. St. John's-wort.

Sepals 5, somewhat equal. Petals 5, oblique, convolute in the bud. Stamens commonly united or clustered in 3–5 parcels; no interposed glands. Pod 1-celled or 3–5-celled. Seeds usually cylindrical.—Herbs or shrubs, with cymose yellow flowers. (An ancient Greek name, of obscure meaning.)

§ 1. *Stamens very numerous, obscurely if at all clustered; styles 3, more or less united into one, the stigmas not capitate; sepals mostly foliaceous.*

* *Perennial herbs or a little woody at the base.*

† *Pod 1-celled with 3 parietal placentæ.*

1. **H. ellipticum,** Hook. Stem simple, herbaceous (10–20′ high), obscurely 4-angled; *leaves spreading, elliptical-oblong*, obtuse, usually narrower toward the subclasping base, thin; cyme nearly naked, rathered few-flowered; *sepals oblong; pods ovoid, very obtuse;* seeds minutely striate.—Wet places, N.S., westward. July, Aug. —Petals light yellow, 3″ long.

§ 2. *Stamens very many, in 3 or 5 clusters; styles 3, separate and usually diverging; pod 3-celled; calyx erect; petals and anthers with black dots; perennials.*

2. **H. perforatum,** L. Common St. John's-wort. Stem much branched and corymbed, somewhat 2-edged (producing runners from the base); leaves elliptical-oblong or linear-oblong, with pellucid dots; petals (deep yellow) twice the length of the *lanceolate acute sepals;* flowers numerous, in open leafy cymes.—Fields, etc., N.S. to Ont. June–Sept.—Too well known as a pernicious weed, which it is difficult to extirpate. Juice very acrid. (Nat. from Eu.)

3. **H. maculatum,** Walt. Conspicuously marked with both black and pellucid dots; stem terete, sparingly branched; leaves

oblong or lance-ovate, the base either obtuse or somewhat clasping; *flowers crowded* (small); *petals pale yellow*, much longer than the *oblong sepals*, styles mostly not longer than the pod. (H. corymbosum, *Muhl.*)—Damp places, N.S. to Ont., common. July–Sept. —Leaves larger and flowers much smaller than in the last; petals 2–3″ long, marked with black lines as well as dots. The ordinary northern form differs from the typical southern one in the shorter style and the more oblong less clasping leaves.

§ 3. *Stamens* 5–12, *distinct or in* 3 *clusters; pod* 1-*celled, with* 3 *strictly parietal placentæ; styles short, distinct, with capitate stigmas; petals oblong or linear; sepals narrow, erect; slender annuals, with* 4-*angular branches; flowering all summer.*

* *Stem simple or loosely branched; leaves linear to ovate, spreading.*

4. **H. mutilum,** L. Stem flaccid, widely branching (6–20′ high); *leaves ovate to narrowly oblong, obtuse, partly clasping,* 5-*nerved;* cymes leafy; flowers 2″ broad; *pods ovate-conical, rather longer than the calyx.*—Low grounds, everywhere.

5. **H. Canadense,** L. Stem strict (6–15′ high), with the branches erect; *leaves linear,* 3-*nerved* at the base, obtuse; cymes naked; flowers deep yellow, 2–3″ broad when expanded; *pods conical-oblong, usually much longer than the calyx.*—Wet, sandy soil; common. June–Oct.

ORDER 14. MALVACEÆ (MALLOW FAMILY).

Herbs or shrubs, with alternate stipulate leaves and regular flowers, the calyx valvate and the corolla convolute in the bud, numerous stamens monadelphous in a column, and united at base with the short claws of the petals, 1-*celled anthers, and kidney-shaped seeds.*—Sepals 5, united at base, persistent, often involucellate with a whorl of bractlets forming a sort of exterior calyx. Petals 5. Anthers kidney-shaped, opening along the top. Pistils several, the ovaries united in a ring or forming a several-celled pod. Seeds with little albumen; embryo curved, the leafy cotyledons variously doubled up. Mucilaginous, innocent plants, with tough bark and palmately-veined leaves. Flower-stalks with a joint, axillary.

Tribe I. MALVEÆ. Columns of stamens anther-bearing at the top. Ovaries and carpels 5–20 or more, closely united in a ring around a central axis, from which they separate after ripening.

* Stigmas occupying the inner face of the styles; carpels 1-seeded, falling away separately.

1. **Malva.** Involucel of 3 bractlets. Petals obcordate. Carpels rounded, beakless.

1. MALVA, L. Mallow.

Calyx with a 3-leaved involucel at the base, like an outer calyx. Petals obcordate. Styles numerous, stigmatic down the inner side. Fruit depressed, separating at maturity into as many 1-seeded and indehiscent round kidney-shaped blunt carpels as there are styles. Radicle pointing downward. (An old Latin name, from the Greek name, μαλάχη, having allusion to the emollient leaves.)

* *Flowers fascicled in the axils.*

1. **M. rotundifolia**, L. Common Mallow. *Stems procumbent* from a deep biennial root; *leaves* round-heart-shaped, on very long petioles, crenate, *obscurely-lobed;* petals twice the length of the calyx, whitish; carpels pubescent, even.—Waysides and cultivated grounds, N. S. to W. Ont., common. (Nat. from Eu.)

** *Flowers only in the upper axils, somewhat racemose or paniculate.*

2. **M. moschata**, L. Musk M. A low perennial, with the *stem-leaves 5-parted, and the divisions once or twice parted or cleft* into linear lobes, faintly musky-scented, the *flowers rose-color* or white ($1\frac{1}{2}'$ in diameter) on short peduncles crowded on the stem and branches, the fruit downy.—Escaped from gardens to waysides, common. (Adv. from Eu.)

Order 15. TILIACEÆ (Linden Family).

Trees (rarely herbs), with the mucilaginous properties, fibrous bark, valvate calyx, etc., of the Mallow Family; *but the sepals deciduous, petals imbricated in the bud, the stamens usually polyadelphous, and the anthers 2-celled.* Represented in Northern regions only by the genus,

1. TILIA, Tourn. Linden. Basswood.

Sepals 5. Petals 5, spatulate-oblong. Stamens numerous; filaments cohering in 5 clusters with each other (in European species), or with the base of a spatulate petal-like body placed opposite each of the real petals. Pistil with a 5-celled ovary, and 2 half-anatropous ovules in each cell, a single style, and a 5-toothed stigma. Fruit dry and woody, indehiscent-globular, becoming 1-celled and

1-2-seeded. Embryo in hard albumen; cotyledons broad and thin, 5-lobed, crumpled.—Fine trees, with soft and white wood, very fibrous and tough inner bark, more or less heart-shaped and serrate alternate leaves (oblique and often truncate at the base), deciduous stipules, and small cymes of flowers, hanging on an axillary peduncle which is united to a ligulate membranaceous bract. Flowers cream color, honey-bearing, fragrant. (The classical Latin name.)

1. **T. Americana,** L. BASSWOOD. Leaves large, green and glabrous or nearly so, thickish; floral bract usually tapering at base; fruit ovoid.—Rich woods; N.B., westward. May, June.—Here rarely called *Lime-tree*, oftener *White-wood*, commonly *Basswood*—the latter name now obsolete in England.

2. **T. Europæa,** L. The EUROPEAN LINDEN, several varieties of which are planted in and near our cities for shade, is at once distinguished from any native species by the absence of the petal-like scales among the stamens. This tree (the *Lin*) gave the family name to *Linnæus*. N.S. to Ont.

B. DISCIFLORÆ. Stamens as many as the petals or twice as many or fewer, inserted upon or at the outer or inner base of a more or less tumid hypogynous or perigynous disk, which is cushion-like or annular or divided into glands, sometimes obscure or minute (or none in Linum, Ilex, some Geraniaceæ and Polygala); ovary superior (or half-inferior in some Rhamnaceæ); sepals more usually distinct. Petals wanting in some Rutaceæ, Rhamnaceæ and Sapindaceæ.

ORDER 16. GERANIACEÆ (GERANIUM FAMILY).

Plants (chiefly herbs) with perfect and generally symmetrical hypogynous flowers; the stamens, counting sterile filaments, as many or commonly twice as many, and the lobes or cells (1-few-ovuled) of the ovary as many, as the sepals, the axis of the dry fruit persisting.—Seeds without albumen except in Oxalis. Flowers mostly 5-merous and the sepals usually distinct. Leaves never punctate. An order not easily defined, and including several strongly-marked tribes or sub-orders which have been regarded by many botanists as distinct.

Tribe I. GERANIEÆ. (GERANIUM FAMILY proper.) Flowers regular, 5-merous, the sepals imbricate in the bud, persistent. Glands of the disk 5, alternate with the petals. Stamens somewhat united. Ovary deeply lobed; carpels 5, 2-ovuled,

1-seeded, separating elastically with their long styles, when mature, from the elongated axis. Cotyledons plicate, incumbent on the radicle.—Herbs (our species) with more or less lobed or divided leaves, stipules, and astringent roots.

1. **Geranium.** Stamens with anthers 10, rarely 5. The recurving bases of the styles or tails of the carpels in fruit naked inside.

Tribe II. OXALIDEÆ. (SORREL FAMILY.) Flowers regular, 5-merous, the persistent sepals imbricate. Glands none. Stamens 10, often united at base. Stigmas capitate. Fruit a 5-celled loculicidal pod (in Oxalis); cells 2-several-seeded. Embryo straight, in a little fleshy albumen.—Leaves compound (3-foliolate in our species); juice sour.

2. **Oxalis.** Styles 5, separate. Pod oblong; the valves not falling away. Leaflets usually obcordate.

Tribe III. BALSAMINEÆ. (BALSAM FAMILY.) Flowers irregular (5-merous as to the stamens and pistil), the petals and colored sepals fewer in number, deciduous, the larger sepal with a large sac or spur. Glands none. Stamens 5, distinct, short. Fruit a fleshy 5-celled pod (in Impatiens); cells several-seeded. Embryo straight.—Tender and very succulent herbs, with simple leaves and no stipules.

3. **Impatiens.** Lateral petals unequally 2-lobed. Pod bursting elastically into 5 valves.

1. GERANIUM, Tourn. CRANESBILL.

Stamens 10 (sometimes only 5 in n. 3), all with perfect anthers, the 5 longer with glands at their base (alternate with the petals). Styles smooth inside in fruit when they separate from the axis.—Stems forking. Peduncles 1–3-flowered. (An old Greek name, from *γέρανος, a crane*; the long fruit-bearing beak thought to resemble the bill of that bird.)

* *Rootstock perennial.*

1. **G. maculatum,** L. WILD CRANESBILL. Stem erect, hairy; leaves about 5-parted, the wedge-shaped divisions lobed and cut at the end; sepals slender-pointed; petals entire, light purple, bearded on the claw ($\frac{1}{2}'$ long).—Open woods and fields, N.S. to Ont. and westward. April–July.—Leaves somewhat blotched with whitish as they grow old.

** *Root biennial or annual; flowers small.*

† *Leaves ternately much-dissected; heavy scented.*

2. **G. Robertianum,** L. HERB ROBERT. Sparsely hairy, diffuse, strong-scented; leaves 3-divided or pedately 5-divided, the divisions twice pinnatifid; sepals awned, shorter than the (red-purple) petals; carpels wrinkled; seeds smooth.—Moist woods and shaded ravines; N.S., Ont. and westward. June–Oct. (Eu.)

†† *Leaves palmately lobed or dissected.*

3. **G. Carolinianum,** L. Stems at first erect, diffusely branched from the base, hairy; leaves about 5-parted, the divisions cleft and cut into numerous oblong-linear lobes; peduncles and pedicels short; *sepals awn-pointed*, as long as the emarginate (pale rose-colored) petals; carpels hairy; *seeds ovoid-oblong, very minutely reticulated.*—Barren soil and waste places; common. May–Aug.

2. OXALIS, L. Wood-Sorrel.

Sepals 5, persistent. Petals 5, sometimes united at base, withering after expansion. Stamens 10, usually monadelphous at base, alternately shorter. Styles 5, distinct. Pod oblong, membranaceous, 5-celled, more or less 5-lobed, each cell opening on the back; valves persistent, being fixed to the axis by the partitions. Seeds 2 or more in each cell, pendulous from the axis, anatropous, their outer coat loose and separating. Embryo large and straight in fleshy albumen; cotyledons flat.—Herbs, with sour watery juice, alternate or radical leaves, mostly of 3 obcordate leaflets, which close and droop at nightfall. Several species produce small peculiar flowers, precociously fertilized in the bud and particularly fruitful; and the ordinary flowers are often dimorphous or even trimorphous in the relative length of the stamens and styles. (Name from ὀξύς, *sour.*)

* *Stemless perennials; leaves and scapes arising from a rootstock or bulb; leaflets broadly obcordate; flowers nearly* 1′ *broad; cells of the pod few-seeded.*

1. **O. Acetosella,** L. Common Wood-Sorrel. *Rootstock creeping* and scaly-toothed; *scape 1-flowered* (2–5′ high); petals white with reddish veins, often notched.—Deep cold woods, N.S. to L. Superior, and northward. June. (Eu.)

3. IMPATIENS, L. Balsam. Jewel-weed.

Calyx and corolla colored alike and not clearly distinguishable. Sepals apparently only 4; the anterior one notched at the apex and probably consisting of two combined; the posterior one (appearing anterior as the flower hangs on its stalk) largest, and forming a spurred sac. Petals 2, unequal-sided and 2-lobed (each consisting of a pair united). Stamens 5, short; filaments append-

aged with a scale on the inner side, the 5 scales connivent and united over the stigma; anthers opening on the inner face. Ovary 5-celled; stigma sessile. Pod with evanescent partitions, and a thick axis bearing several anatropous seeds, 5-valved, the valves coiling elastically and projecting the seeds in bursting. Embryo straight; albumen none.—Leaves simple, alternate, without stipules, in our species ovate or oval, coarsely toothed, petioled. Flowers axillary or panicled, often of two sorts, viz.,—the larger ones, which seldom ripen seeds; and very small ones, which are fertilized early in the bud; their floral envelopes never expand, but are forced off by the growing pod and carried upward on its apex. (Name from the sudden bursting of the pods when touched, whence also the popular appellation, *Touch-me-not* or *Snap-weed.*)

1. **I. pallida,** Nutt. Pale Touch-me-not. *Flowers pale-yellow, sparingly dotted* with brownish-red; sac dilated and very obtuse, broader than long, tipped with a short incurved spur.—Moist shady places and along rills, in rich soil; Montreal, westward. July–September.—Larger and greener than the next, with larger flowers, and less frequent.

2. **I. fulva,** Nutt. Spotted Touch-me-not. *Flowers orange-color, thickly spotted with reddish-brown;* sac longer than broad, acutely conical, tapering into a *strongly inflexed spur* half as long as the sac.—Rills and shady moist places; common, especially southward. June–September.—Plant 2–4° high; the flowers loosely panicled, hanging gracefully on their slender nodding stalks, the open mouth of the cornucopiæ-shaped sepal upward. Spur rarely wanting. Spotless forms of both species occur.

Order 17. **RUTACEÆ** (Rue Family).

Plants with simple or compound leaves, dotted with pellucid glands and abounding with a pungent or bitter-aromatic acrid volatile oil, producing hypogynous almost always regular 3–5-merous flowers, the stamens as many or twice as many as the sepals (rarely more numerous); the 2–5 pistils separate or combined into a compound ovary of as many cells, raised on a prolongation of the receptacle or glandular disk.—Embryo large, curved or straight, usually in fleshy albumen. Styles commonly united or cohering, even when the

ovaries are distinct. Fruit usually capsular. Leaves alternate or opposite. Stipules none.—A large family, chiefly of the Old World and the southern hemisphere.

1. **Xanthoxylum.** Flowers diœcious; ovaries 3-5, separate, forming fleshy pods.

1. XANTHOXYLUM, L. Prickly Ash.

Flowers diœcious. Sepals 4 or 5, obsolete in one species. Petals 4 or 5, imbricated in the bud. Stamens 4 or 5 in the sterile flowers, alternate with the petals. Pistils 2–5, separate, but their styles conniving or slightly united. Pods thick and fleshy, 2-valved, 1-2-seeded. Seed-coat crustaceous, black, smooth and shining. Embryo straight, with broad cotyledons.—Shrubs or trees, with mostly pinnate leaves, the stems and often the leafstalks prickly. Flowers small, greenish or whitish. (From ξανθός, *yellow*, and ξύλον, *wood.*)

1. X. **Americanum**, Mill. Northern Prickly Ash. Toothache-tree. Leaves and flowers in sessile axillary umbellate clusters; leaflets 2–4 pairs and an odd one, ovate-oblong, downy when young; calyx none; petals 4–5; pistils 3–5, with slender styles; pods short-stalked.—Rocky woods and river banks; common, Montreal and Ont. April, May.

Order 18. ILICINEÆ (Holly Family).

Trees or shrubs, with small axillary 4–8-merous flowers, a minute calyx free from the 4–8-celled ovary and the 4–8-seeded berry-like drupe; the stamens as many as the divisions of the almost or quite 4–8-petalled corolla and alternate with them, attached to their very base.—Corolla imbricated in the bud. Anthers opening lengthwise. Stigmas 4-8, or united into one, nearly sessile. Seeds suspended and solitary in each cell, anatropous, with a minute embryo in fleshy albumen. Leaves simple, mostly alternate. Flowers white or greenish.

1. **Ilex.** Petals or corolla-lobes oval or obovate. Pedicels mostly clustered.
2. **Nemopanthes.** Petals linear. Pedicels solitary.

1. ILEX, L. Holly.

Flowers more or less diœciously polygamous. Calyx 4–6-toothed. Petals 4–6, separate, or united only at the base, oval or obovate, obtuse, spreading. Stamens 4–6. The berry-like drupe containing

4–6 little nutlets.—Leaves alternate. Fertile flowers inclined to be solitary and the sterile or partly sterile flowers to be clustered in the axils.

§ 1. PRINOS. *Parts of the sterile flowers commonly in fours, fives, or sixes, those of the fertile flowers commonly in sixes (rarely in fives, sevens or eights); nutlets smooth and even; shrubs.*

* *Leaves deciduous; flowers in sessile clusters, or the fertile solitary; fruit bright red.*

1. **I. verticillata**, Gray. BLACK ALDER. WINTERBERRY. *Leaves* oval, obovate, or wedge-lanceolate, pointed, acute at base, serrate, *downy on the veins beneath; flowers all very short-peduncled.*—Low grounds; common, N. S. to Ont. May, June.

2. NEMOPANTHES, Raf. MOUNTAIN HOLLY.

Flowers polygamo-diœcious. Calyx in the sterile flowers of 4–5 minute deciduous teeth, in the fertile ones obsolete. Petals 4–5, oblong-linear, spreading, distinct. Stamens 4–5; filaments slender. Drupe with 4–5 bony nutlets, light red.—A much-branched shrub, with ash-gray bark, alternate and oblong deciduous leaves on slender petioles, entire or slightly toothed, smooth. Flowers on long slender axillary peduncles, solitary or sparingly clustered. (Name said by the author to mean "flower with a filiform peduncle," therefore probably composed of νῆμα, *a thread*, ποῦς, *foot*, and ἄνθος, *flower*.)

1. **N. fascicularis**, Raf. (N. Canadensis, *DC.*)—Damp cold woods, N.S., Q., and Ont. May.

ORDER 19. CELASTRACEÆ (STAFF-TREE FAMILY).

Shrubs with simple leaves, and small regular flowers, the sepals and the petals both imbricated in the bud, the 4 or 5 perigynous stamens as many as the petals and alternate with them, inserted on a disk which fills the bottom of the calyx and sometimes covers the ovary. Seeds arilled. Ovules one or few (erect or pendulous) in each cell, anatropous; styles united into one. Fruit 2–5-celled, free from the calyx. Embryo large, in fleshy albumen; cotyledons broad and thin. Stipules minute and fugacious. Pedicels jointed.

* Leaves alternate. Flowers in terminal racemes.

1. **Celastrus.** A shrubby climber. Fruit globose, orange, 3-valved. Aril scarlet.

1. CELASTRUS, L. Staff-tree. Shrubby Bitter-sweet.

Flowers polygamo-diœcious. Petals (crenulate) and stamens 5, inserted on the margin of a cup-shaped disk which lines the base of the calyx. Pod globose (orange-color and berry-like), 3-celled, 3-valved, loculicidal. Seeds 1 or 2 in each cell, erect, enclosed in a pulpy scarlet aril.—Leaves alternate. Flowers small, greenish, in raceme-like clusters terminating the branches. (An ancient Greek name for some evergreen, which our plant is not.)

1. C. scandens, L. Wax-work. Climbing Bitter-sweet. Twining shrub; leaves ovate-oblong, finely serrate, pointed.—Along streams and thickets, Q., Ont., and westward. June.—The opening orange-colored pods, displaying the scarlet covering of the seeds, are very ornamental in autumn.

Order 20. RHAMNACEÆ (Buckthorn Family).

Shrubs or small trees, with simple leaves, small and regular flowers (sometimes apetalous), with the 4 or 5 perigynous stamens as many as the valvate sepals and alternate with them, accordingly opposite the petals! Drupe or pod with only one erect seed in each cell, not arilled.—Petals folded inwards in the bud, hooded or concave, inserted along with the stamens into the edge of the fleshy disk which lines the short tube of the calyx and sometimes unites it to the lower part of the 2–5-celled ovary. Ovules solitary, anatropous. Stigmas 2–5. Embryo large, with broad cotyledons, in sparing fleshy albumen.—Flowers often polygamous, sometimes diœcious. Leaves mostly alternate; stipules small or obsolete. Branches often thorny. (Slightly bitter and astringent; the fruit often mucilaginous, commonly rather nauseous or drastic.)

* Calyx and disk free from the ovary.

1. **Rhamnus.** Petals small, short-clawed, notched, or none. Drupe berry-like, with 2–4 separate seed-like nutlets.

* * Calyx with the disk adherent to the base of the ovary.

2. **Ceanothus.** Petals long-clawed, hooded. Fruit dry, at length dehiscent.

1. RHAMNUS, Tourn. Buckthorn.

Calyx 4–5-cleft; the tube campanulate, lined with the disk. Petals small, short-clawed, notched at the end, wrapped around the short stamens, or sometimes none. Ovary free, 2–4 celled.

Drupe berry-like (black), containing 2–4 separate seed-like nutlets, of cartilaginous texture.—Shrubs or small trees, with loosely pinnately veined leaves, and greenish polygamous or diœcious flowers, in axillary clusters. (The ancient Greek name.)

§ 1. RHAMNUS proper. *Flowers usually diœcious; nutlets and seeds deeply grooved on the back; rhaphe dorsal; cotyledons foliaceous, the margins revolute.*

* *Calyx-lobes and stamens* 5; *petals wanting.*

1. **R. alnifolia**, L'Her. A low shrub; leaves oval, acute, serrate, nearly straight-veined; fruit 3-seeded.—Swamps, N.B. to Ont. and westward. June.

2. CEANOTHUS, L. New Jersey Tea. Red-root.

Calyx 5-lobed, incurved; the lower part cohering with the thick disk to the ovary, the upper separating across in fruit. Petals hooded, spreading, on slender claws longer than the calyx. Filaments elongated. Fruit 3-lobed, dry and splitting into its 3 carpels when ripe.—Shrubby plants; flowers in little umbel-like clusters, forming dense panicles or corymbs at the summit of naked flower-branches; calyx and pedicels colored like the petals. (An obscure name in Theophrastus, probably mis-spelled.)

1. **C. Americanus**, L. New Jersey Tea. Leaves ovate or oblong-ovate, 3-ribbed, serrate, more or less pubescent, often slightly heart-shaped at base; common peduncles elongated.—Dry woodlands, Ont. July.—Stems 1–3° high from a dark red root; branches downy. Flowers in pretty white clusters, on leafy shoots of the same year. The leaves were used for tea during the American Revolution.

Order 21. VITACEÆ (Vine Family).

Shrubs with watery juice, usually climbing by tendrils, with small regular flowers, a minute or truncated calyx, its limb mostly obsolete, and the stamens as many as the valvate petals and opposite them! Berry 2-celled, usually 4-seeded.—Petals 4–5, very deciduous, hypogynous or perigynous. Filaments slender; anthers introrse. Pistil with a short style or none, and a slightly 2-lobed stigma; ovary 2-celled, with 2 erect anatropous ovules from the base of each cell. Seeds bony, with a minute embryo at the base of the

hard albumen, which is grooved on one side.—Stipules deciduous. Leaves alternate, palmately veined or compound; tendrils and flower-clusters opposite the leaves. Flowers small, greenish, commonly polygamous. (Young shoots, foliage, etc., acid.)

* Ovary surrounded by a nectariferous or glanduliferous disk; plants climbing by the coiling of naked-tipped tendrils.

1. **Vitis.** Corolla caducous without expanding. Hypogynous glands 5, alternate with the stamens. Fruit pulpy. Leaves simple.

* * No distinct hypogynous disk; plants climbing by the adhesion of the dilated tips of the tendril-branches, or by naked-tipped tendrils.

2. **Ampelopsis.** Corolla expanding. Leaves digitate.

1. VITIS, Tourn. GRAPE.

Flowers polygamo-diœcious (some plants with perfect flowers, others staminate with at most a rudimentary ovary), 5-merous. Calyx very short, usually with a nearly entire border or none at all. Petals separating only at base and falling off without expanding. Hypogynous disk of 5 nectariferous glands alternate with the stamens. Berry pulpy. Seeds pyriform, with peak-like base.—Plants climbing by the coiling of naked-tipped tendrils. Flowers in a compound thyrse, very fragrant; pedicels mostly umbellate-clustered. Leaves simple, rounded and heart-shaped. (The classical Latin name.)

§ 1. VITIS proper. *Bark loose and shreddy; tendrils forked; nodes solid.*

† *Tendrils intermittent (none opposite each third leaf).*

‡ *Leaves glabrous and mostly shining, or short-hairy especially on the ribs beneath, incisely lobed or undivided.*

1. **V. cordifolia,** Michx. FROST OR CHICKEN GRAPE. Leaves 3–4′ wide, not lobed or slightly 3-lobed, cordate with a deep acute sinus, acuminate, coarsely and sharply toothed; stipules small; inflorescence ample, loose; berries small, black and shining, very acerb, ripening after frosts; seeds 1 or 2, rather large, with a prominent rhaphe.—Thickets and stream banks. N.S., Q., Man., Neb., and southward. May, June.

2. **V. riparia,** Michx. Differing from the last in the larger and more persistent stipules (2–3″ long), more shining and more usually 3-lobed leaves with a broad rounded or truncate sinus and

large acute or acuminate teeth, smaller compact inflorescence, and berries (4–5″ broad) with a bloom, sweet and very juicy, ripening from July to Sept.; seeds very small; rhaphe indistinct. (V. cordifolia, var. riparia, *Gray*.)—Stream banks or near water. N.B., Ont., and westward. Eastward the berries are sour and ripen late.

2. AMPELOPSIS, Michx. VIRGINIAN CREEPER.

Calyx slightly 5-toothed. Petals concave, thick, expanding before they fall. Disk none.—Leaves digitate, with 5 (3–7) oblong-lanceolate sparingly serrate leaflets. Flower-clusters cymose. Tendrils fixing themselves to trunks or walls by dilated sucker-like disks at their tips or sometimes without disks. (Name from ἄμπελος, *a vine*, and ὄψις, *appearance*.)

1. **A. quinquefolia**, Michx. A common woody vine, in low or rich grounds, climbing extensively, sometimes by rootlets as well as by its disk-bearing tendrils, blossoming in July, ripening its small blackish berries in October. Also called *American Ivy*, and still less appropriately *Woodbine*. Leaves turning bright crimson in autumn. Q. to Man.

ORDER 22. SAPINDACEÆ (SOAPBERRY FAMILY).

Trees or shrubs, with simple or compound leaves, mostly unsymmetrical and often irregular flowers; the 4–5 sepals and petals imbricated in æstivation; the 5–10 stamens inserted on a fleshy (perigynous or hypogynous) disk; a 2–3-celled and -lobed ovary, with 1–2 (rarely more) ovules in each cell; and the embryo (except Staphylea) *curved or convolute, without albumen.*—A large and diverse order.

SUB-ORDER I. **Acerineæ** (MAPLE FAMILY). Flowers (polygamous or diœcious) small, regular, but usually unsymmetrical. Petals often wanting. Ovary 2-lobed and 2-celled, with a pair of ovules in each cell. Fruits winged, 1-seeded. Embryo coiled or folded; the cotyledons long and thin.—Leaves opposite, simple or compound.

1. **Acer.** Flowers polygamous. Leaves simple.

SUB-ORDER II. **Staphyleæ** (BLADDER-NUT FAMILY). Flowers (perfect) regular; stamens as many as the petals. Ovules 1–8 in each cell. Seeds bony, with a straight embryo in scanty albumen.

—Shrubs with opposite pinnately compound leaves, both stipulate and stipellate.

2. **Staphylea.** Lobes of the colored calyx and petals 5, erect. Stamens 5. Fruit a 3-celled bladdery-inflated pod.

1. ACER, Tourn. MAPLE.

Flowers polygamo-diœcious. Calyx colored, 5- (rarely 4–12) lobed or parted. Petals either none or as many as the lobes of the calyx, equal, with short claws if any, inserted on the margin of the lobed disk, which is either perigynous or hypogynous. Stamens 3–12. Ovary 2-celled, with a pair of ovules in each cell; styles 2, long and slender, united only below, stigmatic down the inside. From the back of each carpel grows a wing, converting the fruit into two 1-seeded, at length separable samaras or keys. Embryo variously coiled or folded, with large and thin cotyledons.—Trees, or sometimes shrubs, with opposite palmately-lobed leaves, and small flowers. Pedicels not jointed. (The classical name, from the Celtic *ac*, hard.)

* *Flowers in terminal racemes, greenish, appearing after the leaves; stamens 6–8.*

1. **A. Pennsylvanicum,** L. STRIPED MAPLE. Leaves 3-lobed at the apex, finely and sharply doubly serrate, the short lobes taper-pointed and also serrate; *racemes drooping, loose; petals obovate;* fruit with large diverging wings.—Rich woods, N.S., Q., and Ont. June.—A small and slender tree, with light-green bark striped with dark lines, and greenish flowers and fruit. Also called *Striped Dog-wood* and *Moose-wood.*

2. **A. spicatum,** Lam. MOUNTAIN M. Leaves downy beneath, 3- (or slightly 5) lobed, coarsely serrate, the lobes taper-pointed; *racemes upright, dense,* somewhat compound; *petals linear-spatulate;* fruit with small erect or divergent wings.—Moist woods, Newf. to Man. June.—A tall shrub, forming clumps.

** *Flowers in nearly sessile terminal and lateral umbellate-corymbs, greenish-yellow, appearing with the leaves.*

3. **A. saccharinum,** Wang. SUGAR or ROCK M. Leaves 3–5-lobed, with rounded sinuses and pointed sparingly sinuate-toothed lobes, either heart-shaped or nearly truncate at the base, whitish

and smooth or a little downy on the veins beneath ; flowers from terminal leaf-bearing and lateral leafless buds, drooping on very slender hairy pedicels ; calyx hairy at the apex ; petals none ; wings of the fruit broad, usually slightly diverging.—Rich woods, Newf. to Ont., and along the mountains southward. April, May.—A large and handsome tree.

Var. **nigrum**, Torr. and Gray. BLACK SUGAR-M. Leaves scarcely paler beneath, but often minutely downy, the lobes wider, often shorter and entire, the sinus at the base often closed.—With the ordinary form ; quite variable, sometimes appearing distinct.

*** *Flowers in umbel-like clusters arising from separate lateral buds, and much preceding the leaves; stamens* 3–6.

4. **A. dasycarpum**, Ehrh. WHITE OR SILVER M. *Leaves very deeply 5-lobed* with the sinuses rather acute, silvery-white (and when young downy) underneath, the divisions narrow, cut-lobed and toothed ; flowers (greenish-yellow) on short pedicels ; *petals none; fruit woolly when young*, with large divergent wings.—River banks ; N.B., Q. and Ont.; most common southward and westward. March–April.—A fine ornamental tree.

5. **A. rubrum**, L. RED OR SWAMP M. *Leaves 3–5 lobed*, with acute sinuses, whitish underneath ; the lobes irregularly serrate and notched, acute, the middle one usually longest ; *petals linear-oblong;* flowers (scarlet, crimson, or sometimes yellowish) on very short pedicels ; but the *smooth fruit* on prolonged drooping pedicels.—Swamps and wet woods, common. April.—A small tree, with reddish twigs ; the leaves varying greatly in shape, turning bright crimson in early autumn.

2. STAPHYLEA, L. BLADDER-NUT.

Calyx deeply 5-parted, the lobes erect, whitish. Petals 5, erect, spatulate, inserted on the margin of the thick perigynous disk which lines the base of the calyx. Stamens 5, alternate with the petals. Pistil of 3 several-ovuled carpels, united in the axis, their long styles lightly cohering. Pod large, membranaceous, inflated, 3-lobed, 3-celled, at length bursting at the summit ; the cells containing 1–4 bony anatropous seeds. Aril none. Embryo large and straight, in scanty albumen, cotyledons broad and thin.—Upright shrubs,

with opposite pinnate leaves of 3 or 5 serrate leaflets, and white flowers in drooping raceme-like clusters, terminating the branchlets. Stipules and stipels deciduous. (Name from *σταφυλή, a cluster.*)

1. **S. trifolia,** L. AMERICAN BLADDER-NUT. Leaflets 3, ovate, pointed.—Thickets, in moist soil. Montreal and Ont. May.—Shrub 10° high, with greenish striped branches.

ORDER 23. ANACARDIACEÆ (CASHEW FAMILY).

Trees or shrubs, with resinous or milky acrid juice, dotless alternate leaves, and small, often polygamous, regular, 5-merous flowers, but the ovary 1-celled and 1-ovuled, with 3 styles or stigmas.—Petals imbricated in the bud. Fruit mostly drupaceous. Seed without albumen, borne on a curved stalk that rises from the base of the cell. Stipules none. Juice or exhalations often poisonous.

1. RHUS, L. SUMACH.

Calyx small, 5-parted. Petals 5. Stamens 5, inserted under the edge or between the lobes of a flattened disk in the bottom of the calyx. Fruit small and indehiscent, a sort of dry drupe.—Leaves usually compound. Flowers greenish-white or yellowish. (The old Greek and Latin name.)

§ 1. RHUS proper. *Fruit symmetrical, with the styles terminal.*

* *Flowers polygamous, in a terminal thyrsoid panicle; fruit globular, clothed with acid crimson hairs; stone smooth; leaves odd-pinnate. (Not poisonous.)*—(§ SUMAC, DC.)

1. **R. typhina,** L. STAGHORN SUMACH. *Branches and stalks densely velvety hairy;* leaflets 11–31, pale beneath, oblong-lanceolate, pointed, serrate, rarely laciniate.—Hillsides. June.—Shrub or tree 10–30° high, with orange-colored wood.

** *Flowers polygamous, in loose and slender axillary panicles; fruit globular, glabrous, whitish or dun-colored; the stone striate; leaves odd-pinnate or 3-foliolate, thin. (Poisonous)*—(§ TOXICODENDRON, DC.)

2. **R. Toxicodendron,** L. POISON IVY. POISON OAK. Climbing by rootlets over rocks, etc., or ascending trees, or sometimes low and erect; *leaflets 3, rhombic-ovate,* mostly pointed, and rather

downy beneath, variously notched, sinuate, or cut-lobed,—high-climbing plants (R. radicans, *L.*) having usually more entire leaves.—Thickets, low grounds. N. S., to N. W. T. June.

ORDER 24. POLYGALACEÆ (MILKWORT FAMILY).

Plants with irregular hypogynous flowers, 4–8 diadelphous or monadelphous stamens, their 1-celled anthers opening at the top by a pore or chink; the fruit a 2-celled and 2-seeded pod.

1. POLYGALA, Tourn. MILKWORT.

Flower very irregular. Calyx persistent, of 5 sepals, of which 3 (the upper and the 2 lower) are small and often greenish, while the two lateral or inner (called *wings*) are much larger, and colored like the petals. Petals 3, hypogynous, connected with each other and with the stamen-tube, the middle (lower) one keel-shaped and often crested on the back. Stamens 6 or 8; their filaments united below into a split sheath, or into 2 sets, cohering more or less with the petals, free above; anthers 1-celled, often cup-shaped, opening by a hole or broad chink at the apex. Ovary 2-celled, with a single anatropous ovule pendulous in each cell; style prolonged and curved; stigma various. Fruit a small, loculicidal 2-seeded pod, usually rounded and notched at the apex, much flattened contrary to the very narrow partition. Seeds carunculate. Embryo large, straight, with flat and broad cotyledons, in scanty albumen.—Bitter plants (low herbs in temperate regions), with simple entire often dotted leaves, and no stipules; sometimes (as in the first two species) bearing cleistogamous flowers next the ground. (An old name composed of *πολύς*, *much*, and *γάλα*, *milk*, from a fancied property of its increasing this secretion.)

* *Perennial or biennial; flowers purple or white; leaves alternate.*

† *Flowers showy, rose-purple, conspicuously crested; also bearing inconspicuous colorless cleistogamous flowers on subterranean branches.*

1. **P. paucifolia,** Willd. *Perennial;* flowering stems short (3–4′ high), from long, slender prostrate or subterranean shoots, which also bear concealed fertile flowers; lower leaves small and scale-like, scattered, the *upper ovate, petioled, crowded* at the summit;

flowers 1–3, *large*, peduncled; wings obovate, rather shorter than the fringe-crested keel; stamens 6; caruncle of 2 or 3 awl-shaped lobes longer than the seed.—Woods, in light soil, N. B. to Ont., and southward along the Alleghanies. May.—A delicate plant, with very handsome flowers, 9″ long, rose-purple, or rarely pure white. Sometimes called *Flowering Wintergreen*, but more appropriately FRINGED POLYGALA.

2. **P. polygama**, Walt. Stems numerous from the *biennial* root, mostly simple, ascending, very leafy (6–9′ high); *leaves oblanceolate or oblong;* terminal *raceme loosely many-flowered*, the broadly obovate wings longer than the keel; stamens 8; radical flowers racemed on short subterranean runners; lobes of the caruncle 2, scale-like, shorter than the seed.—Dry sandy soil; N. S. to Ont., common. July.

† † *Flowers white, in a solitary close spike; none cleistogamous.*

3. **P. Senega,** L. SENECA SNAKEROOT. Stems several from thick and hard knotty rootstocks, simple (6–12′ high); leaves lanceolate or oblong-lanceolate, with rough margins; wings round-obovate, concave; crest short; caruncle nearly as long as the seed. —Rocky soil, N. B. to R. Mts. May, June.

C. CALYCIFLORÆ. Sepals rarely distinct; disk adnate to the base of the calyx, rarely tumid or conspicuous; petals and stamens on the calyx, perigynous or epigynous, the ovary being often inferior (hypogynous in Drosera and Parnassia, nearly so in some Leguminosæ and Crassulaceæ). Apetalous flowers in Orders 27, 28, 29, 31, 32, and 36.

ORDER 25. LEGUMINOSÆ (PULSE FAMILY).

Plants with papilionaceous or sometimes regular flowers, 10 (*rarely 5 and sometimes many*) *monadelphous, diadelphous, or rarely distinct stamens, and a single simple free pistil, becoming a legume in fruit. Seeds mostly without albumen. Leaves alternate, with stipules, usually compound.* One of the sepals inferior (*i.e.*, next the bract); one of the petals superior (*i.e.*, next the axis of the inflorescence). —A very large order (nearly free from noxious qualities), of which the principal representatives in northern temperate regions belong to the first of the three sub-orders it comprises.

SUB-ORDER I. **Papilionaceæ.** Calyx of 5 sepals, more or less united, often unequally so. Corolla inserted into the base of the calyx, of 5 irregular petals (or very rarely fewer), more or less distinctly *papilionaceous, i.e.*, with the upper or odd petal (*vexillum* or *standard*) larger than the others and enclosing them in the bud, usually turned backward or spreading; the two lateral ones (*wings*) oblique and exterior to the two lower, which last are connivent and commonly more or less coherent by their anterior edges, forming the *carina* or *keel*, which usually encloses the stamens and pistil. Stamens 10, very rarely 5, inserted with the corolla, monadelphous, diadelphous (mostly with 9 united into a tube which is cleft on the upper side, and the tenth or upper one separate), or occasionally distinct. Ovary 1-celled, sometimes 2-celled by an intrusion of one of the sutures, or transversely 2–many-celled by cross-division into joints; style simple; ovules amphitropous, rarely anatropous. Cotyledons large, thick or thickish; radicle incurved.—Leaves simple or simply compound, the earliest ones in germination usually opposite, the rest alternate; leaflets almost always quite entire. Flowers perfect, solitary and axillary, or in spikes, racemes, or panicles.

I. Stamens monadelphous, or diadelphous (9 and 1, rarely 5 and 5).

* Anthers uniform.

† Leaves digitately (rarely pinnately) 3-foliolate; leaflets denticulate or serrulate; stamens diadelphous; pods small, 1–few seeded, often enclosed in the calyx or curved or coiled. (TRIFOLIEÆ.)

1. **Trifolium.** Flowers capitate. Pods membranaceous, 1–6-seeded. Petals adherent to the stamen-tube.
2. **Melilotus.** Flowers racemed. Pod coriaceous, wrinkled, 1–2-seeded.
3. **Medicago.** Flowers racemed or spiked. Pods curved or coiled, 1–few-seeded.

† † Leaves unequally pinnate; pod not jointed; not twining nor climbing.

‡ Flowers in spikes, racemes, or heads. (GALEGEÆ.)

‖ Herbage not glandular-dotted; stamens mostly diadelphous; pod 2-valved, several-seeded; leaves pinnately several-foliolate; flowers racemose.

a. Flowers large and showy; standard broad; wings free; woody; leaflets stipellate.

4. **Robinia.** Pod flat, thin, margined on one edge. Trees or shrubs.

b. Standard narrow, erect; pod turgid or inflated; perennial herbs.

5. **Astragalus.** Keel not tipped with a point or sharp appendage. Pod with one or both the sutures turned in, sometimes dividing the cell lengthwise into two.
6. **Oxytropis.** Keel tipped with an erect point; otherwise as Astragalus.

††† Herbs with pinnate or pinnately 1–3-foliolate leaves; no tendrils; pod transversely 2–several-jointed, the reticulated 1-seeded joints indehiscent, or sometimes reduced to 1 such joint. (HEDYSAREÆ.)

‖ Leaves pinnate, with several leaflets, not stipellate.

7. **Hedysarum.** Stamens unequally diadelphous (9 and 1). Calyx 5-cleft. Pod several-jointed; joints roundish.

‖ ‖ Leaves pinnately 3-foliolate, rarely 1-foliolate.

8. **Desmodium.** Stamens diadelphous (9 and 1) or monadelphous below. Calyx 2-lipped. Pod several-jointed. Flowers all of one sort and complete. Leaflets stipellate.

†††† Herbs with abruptly pinnate leaves, terminated by a tendril or bristle; stamens diadelphous; pod continuous, 2-valved, few–several-seeded. (VICIEÆ.)

9. **Vicia.** Wings adherent to the keel. Style filiform, bearded with a tuft or ring of hairs at the apex.

10. **Lathyrus.** Wings nearly free. Style somewhat dilated and flattened upwards, bearded down the inner face.

††††† Twining (sometimes only trailing) herbs; leaves pinnately 3- (rarely 1 or 5–7) foliolate; no tendrils; peduncles or flowers axillary; pod not jointed, 2-valved. (PHASEOLEÆ.)

‖ Leaves pinnate.

11. **Apios.** Herbaceous twiner; leaflets 5–7. Keel slender and much incurved or coiled.

‖ ‖ Leaves 3-foliolate. Ovules and seeds several. Flowers not yellow.

12. **Amphicarpæa.** Calyx tubular, 4–5-toothed. Standard erect; keel almost straight. Style beardless. Some nearly apetalous fertile flowers next the ground.

1. TRIFOLIUM, Tourn. CLOVER. TREFOIL.

Calyx persistent, 5-cleft, the teeth bristle-form. Corolla mostly withering or persistent; the claws of all the petals, or of all except the oblong or ovate standard, more or less united below with the stamen-tube; keel short and obtuse. Tenth stamen more or less separate. Pods small and membranous, often included in the calyx, 1–6-seeded, indehiscent, or opening by one of the sutures.—Tufted or diffuse herbs. Leaves mostly palmately, sometimes pinnately 3-foliolate; leaflets usually toothed. Stipules united with the petiole. Flowers in heads or spikes. (Name from *tres*, three, and *folium*, a leaf.)

* *Flowers sessile in dense heads; corolla purple or purplish, withering away after flowering, tubular below, the petals more or less coherent with each other.*

† *Calyx-teeth silky-plumose, longer than the whitish corolla; root annual.*

1. **T. arvense,** L. Rabbit-foot or Stone Clover. Silky, branching (5–10′ high); leaflets oblanceolate; heads becoming very soft-silky and grayish, oblong or cylindrical.—Old fields, N. B. to Ont. (Nat. from Eu.)

†† *Calyx scarcely hairy except a bearded ring in the throat, shorter than the rose-purple elongated-tubular corolla. (Short-lived perennials; flowers sweet-scented.)*

2. **T. pratense,** L. Red C. Stems ascending, somewhat hairy; *leaflets oval or obovate, often notched* at the end and marked on the upper side with a pale spot; *stipules broad, bristle-pointed; heads ovate, sessile.*—Fields and meadows; largely cultivated. (Adv. from Eu.)

** *Flowers pedicelled in umbel-like round heads on a naked penduncle, their short pedicels reflexed when old; corolla white or rose color, withering persistent and turning brownish in fading; the tubular portion short.*

3. **T. repens,** L. White C. Smooth, perennial; the slender *stems spreading and creeping; leaflets inversely heart-shaped* or merely notched, obscurely toothed; stipules scale-like, narrow; petioles and especially the penducles very long; heads small and loose; *calyx much shorter than the white corolla;* pods about 4-seeded.—Fields and copses, everywhere. Indigenous only in the northern part of our range, if at all.

*** *Flowers short-pedicelled in close heads, reflexed when old; corolla yellow, persistent, turning dry and chestnut-brown with age, the standard becoming hood-shaped; annuals, fl. in summer.*

4. **T. agrarium,** L. Yellow or Hop-C. Smoothish, somewhat upright (6–12′ high); *leaflets abovate-oblong, all three from the same point* (palmate) and nearly sessile; *stipules narrow, cohering with the petiole for more than half its length.*—Sandy fields and roadsides; N. Scotia to Ont. (Nat. from Eu.)

5. **T. procumbens,** L. Low Hop-C. Stems spreading or ascending, pubescent (3–6′ high); *leaflets wedge-obovate,* notched at the end, *the lateral at a small distance from the other* (pinnately 3-foliolate); *stipules ovate, short.*—Sandy fields and roadsides, common.—Var. minus, Gray, has smaller heads, the standard not much striate with age. (Nat. from Eu.)

2. MELILOTUS, Tourn. MELILOT. SWEET CLOVER.

Flowers much as in Trifolium, but in spike-like racemes, small; corolla deciduous, free from the stamen-tube. Pod ovoid, coriaceous, wrinkled, longer than the calyx, scarcely dehiscent, 1–2-seeded.—Annual or biennial herbs, fragrant in drying, with pinnately 3-foliolate leaves, leaflets toothed. (Name from μέλι, *honey*, and λωτός, some leguminous plant.)

1. **M. officinalis,** Willd. YELLOW MELILOT. Upright (2–4° high); leaflets obovate-oblong, obtuse; *corolla yellow;* the petals nearly of equal length.—Waste or cultivated grounds. (Adv. from Eu.)

2. **M. alba,** Lam. WHITE M. Leaflets truncate; *corolla white;* the standard longer than the other petals.—In similar places. (Adv. from Eu.)

3. MEDICAGO, Tourn. MEDICK.

Flowers nearly as in Melilotus. Pod 1–several-seeded, scythe-shaped, incurved, or variously coiled.—Leaves pinnately 3-foliolate; leaflets toothed; stipules often cut. (Μηδική, the name of Lucerne, because it came to the Greeks from Media.)

1. **M. lupulina,** L. BLACK MEDICK. NONESUCH. Procumbent, pubescent, annual; leaflets wedge-obovate, toothed at the apex; *flowers in short spikes* (yellow); *pods kidney-form,* 1-seeded. —Waste places, Q. and Ont., west to Mich., Iowa, and Mo. (Adv. from Eu.)

4. ROBINIA, L. LOCUST-TREE.

Calyx short, 5-toothed, slightly 2-lipped. Standard large and rounded, turned back, scarcely longer than the wings and keel. Stamens diadelphous. Pod linear, flat, several-seeded, margined on the seed-bearing edge, at length 2-valved.—Trees or shrubs, often with prickly spines for stipules. Leaves odd-pinnate, the ovate or oblong leaflets stipellate. Flowers showy, in hanging axillary racemes. Base of the leaf-stalks covering the buds of the next year. (Named in honor of *John Robin*, herbalist to Henry IV. of France, and his son *Vespasian Robin*, who first cultivated the Locust-tree in Europe.)

1. **R. Pseudacacia,** L. COMMON LOCUST OR FALSE ACACIA. Branches naked; *racemes slender, loose;* flowers white, fragrant; pod smooth.—S. Penn. to Ind., Iowa, and southward. Commonly cultivated as an ornamental tree, and for its valuable timber; naturalized in many places. N.S. to Ont. June.

5. ASTRAGALUS, Tourn. MILK-VETCH.

Calyx 5-toothed. Corolla usually long and narrow; standard narrow, equalling or exceeding the wings and blunt keel, its sides reflexed or spreading. Stamens diadelphous. Pod several–many-seeded, various, mostly turgid, one or both sutures usually projecting into the cell, either slightly or so as to divide the cavity lengthwise into two.—Chiefly herbs (ours perennials), with odd-pinnate leaves and spiked or racemed flowers. Mature pods are usually necessary for certain identification of the species. (The ancient Greek name of a leguminous plant, as also of the ankle-bone; but the connection between the two is past all guess.)

I. *Pod turgid, completely or imperfectly 2-celled by the intrusion of the dorsal suture, the ventral suture being not at all or less deeply inflexed.*—ASTRAGALUS proper.

* *Pod dry, coriaceous, cartilaginous or membranous, dehiscent.*

† *Pod completely 2-celled, sessile.*

1. **A. Canadensis,** L. *Tall and erect* (1–4° high), *somewhat pubescent or glabrate;* leaflets 21–27, oblong; *flowers greenish cream color,* very numerous, in long dense spikes; pods crowded, oblong (6″ long), glabrous, *terete, scarcely sulcate* and only on the back, nearly straight.—River banks, P.Q., and far westward.

† † *Pod not completely 2-celled.*

2. **A. alpinus,** L. *Diffuse* (6–12′ high), smooth or slightly hairy; leaflets 13–25; flowers *violet-purple,* or at least the keel tipped with violet or blue; calyx campanulate; pod narrowly oblong, short-acuminate, *black-pubescent,* triangular-turgid, deeply grooved on the back, straight or curved, its stipe usually rather exceeding the calyx.—Rocky banks, Lab., north and westward.

6. OXYTROPIS, DC.

Keel tipped with a sharp projecting point or appendage; otherwise as in Astragalus. Pod often more or less 2-celled by the

intrusion of the ventral suture.—Our species are low, nearly acaulescent perennials, with tufts of numerous very short stems from a hard and thick root or rootstock, covered with scaly adnate stipules; pinnate leaves of many leaflets; peduncles scapelike, bearing a head or short spike of flowers. (Name from ὀξύς, *sharp*, and τρόπις, *keel.*)

* *Leaves simply pinnate.*

1. **O. campestris**, DC., var. **cærulea**, Koch. *Pubescent or smoothish;* leaflets lanceolate or oblong; flowers violet or blue, sometimes pure white; *pods* ovate or oblong lanceolate, of a *thin or papery* texture.—Lab. and N. B., westward.

7. HEDYSARUM, Tourn.

Calyx 5-cleft, the lobes awl-shaped and nearly equal. Keel nearly straight, obliquely truncate, not appendaged, longer than the wings. Stamens diadelphous, 9 and 1. Pod flattened, composed of several equal-sided separable roundish joints connected in the middle.—Perennial herbs; leaves odd-pinnate. (Name composed of ἡδύς, *sweet*, and ἄρωμα, *smell.*)

1. **H. boreale**, Nutt. Leaflets 13–21, oblong or lanceolate, nearly glabrous; stipules scaly, united opposite the petiole; raceme of many deflexed purple flowers; standard shorter than the keel; joints of the pod 3 or 4, smooth, reticulated.—Lab. to northern Maine and Vt.; north shore of L. Superior, and north and westward.

8. DESMODIUM, Desv. TICK-TREFOIL.

Calyx usually more or less 2-lipped. Standard obovate; wings adherent to the straight or straightish and usually truncate keel, by means of a little transverse appendage on each side of the latter. Stamens diadelphous, 9 and 1, or monadelphous below. Pod flat, deeply lobed on the lower margin, separating into few or many flat reticulated joints (mostly roughened with minute hooked hairs, by which they adhere to the fleece of animals or to clothing).—Perennial herbs, with pinnately 3-foliolate (rarely 1-foliolate) leaves, stipellate. Flowers (in summer) in axillary or termin[al] racemes, often panicled, and 2 or 3 from each bract, purple or purplish, ofte[n] turning green in withering. Stipules and bracts

scale-like, often striate. (Name from δεσμός, *a bond* or *chain*, from the connected joints of the pods.)

§ 1. *Pod raised on a stalk (stipe) many times longer than the slightly toothed calyx and nearly as long as the pedicel, straightish on the upper margin, deeply sinuate on the lower; the 1–4 joints mostly half-obovate and concave on the back; stamens monadelphous below; plants nearly glabrous; stems erect or ascending; raceme terminal, panicled; stipules bristle-form, deciduous.*

1. **D. nudiflorum,** DC. *Leaves all crowded at the summit of sterile stems;* leaflets broadly ovate, bluntish, whitish beneath; *raceme elongated on an ascending mostly leafless stalk or scape from the root,* 2° long.—Dry woods, common, P. Q. to Ont.

2. **D. acuminatum,** DC. *Leaves all crowded at the summit of the stem, from which arises the elongated naked raceme or panicle;* leaflets round-ovate, taper-pointed, green both sides, the end one round (4–5′ long).—Rich woods, from Canada to the Gulf.

§ 2. *Pod slightly if at all stalked in the calyx; racemes panicled.*

* *Stipules small and inconspicuous, mostly deciduous; pods of few roundish or obliquely oval or sometimes roundish-rhomboidal joints,* $1\frac{1}{2}$–$2\frac{1}{2}''$ *long.*

† *Stems erect; bracts before flowering conspicuous; racemes densely flowered.*

3. **D. Canadense,** DC. Stem hairy (3–6° high); *leaflets oblong-lanceolate* or ovate-lanceolate, obtuse, with numerous straightish veins, *much longer than the petiole* ($1\frac{1}{2}$–3′ long); *flowers showy,* larger than in any other species ($\frac{1}{2}$–$\frac{1}{3}'$ long).—Dry rich woods, N.B. westward to Minn. and Kan.

9. VICIA, Tourn. Vetch. Tare.

Calyx 5-cleft or 5-toothed, the 2 upper teeth often shorter, or the lowest longer. Wings of the corolla adhering to the middle of the keel. Stamens more or less diadelphous (9 and 1); the orifice of the tube oblique. Style filiform, hairy all round or only on the back at the apex. Pod flat, 2-valved, 2–several-seeded. Seeds globular. Cotyledons very thick, remaining under ground in germination.—Herbs, mostly climbing more or less by the tendril

at the end of the pinnate leaves. Stipules half-sagittate. Flowers or peduncles axillary. (The classical Latin name.)

* *Annual; flowers 1 or 2 in the axils, nearly sessile, large, violet-purple.*

1. **V. sativa,** L. Common Vetch or Tare. Somewhat pubescent; stem simple; leaflets 5–7 pairs, varying from obovate-oblong to linear, notched and mucronate at the apex; pod linear, several-seeded.—Cultivated fields and waste places. (Adv. from Eu.)

* * *Annual, slender; peduncles elongated; flowers small.*

2. **V. tetrasperma,** L. *Peduncles 1–2-flowered;* leaflets 4–6 pairs, linear-oblong, obtuse; calyx-teeth unequal; corolla whitish; *pods narrow, 4-seeded, smooth.*—Waste places, N.S., P.Q. and Ont. (Nat. from Eu.)

* * * *Perennial; peduncles elongated; calyx-teeth unequal; pod several-seeded.*

3. **V. Cracca,** L. Downy-pubescent; *leaflets 20–24, oblong-lanceolate, strongly mucronate; spikes densely many-flowered,* 1-sided; flowers blue, turning purple, 6″ long, reflexed; calyx-teeth shorter than the tube.—Borders of thickets, Newf. to Ont., Ky., Iowa, and Minn. (Eu.)

10. **LATHYRUS,** Tourn. Vetchling. Everlasting Pea.

Style flattish, dilated and flattish (not grooved) above, hairy along the inner side (next the free stamen). Sheath of the filaments scarcely oblique at the apex. Otherwise nearly as in Vicia.—Our species are perennial and mostly smooth plants, the rhachis of the leaves in some not produced into a tendril. (Λάθυρος, a leguminous plant of Theophrastus.)

* *Tendrils present; stipules large and broad; leaflets 3–5 pairs.*

1. **L. maritimus,** Bigelow. Beach Pea. Stout (1° high or more); *stipules broadly ovate and halberd-shaped, nearly as large as the leaflets,* the lower lobe larger and usually coarsely toothed; leaflets *thick,* ovate-oblong (1–2′ long); peduncles a little shorter than the leaves, 6–10-flowered, *flowers large* (9″ long), *purple.*—Sea-shore from Lab. and B.C. to the Arctic Sea; also on the Great Lakes. (Eu.)

2. **L. ochroleucus,** Hook. Stem slender (1–3° high); *stipules semi-cordate, half as large as the thin ovate leaflets;* peduncles 7–10-flowered; *flowers smaller, yellowish-white.*—P.Q. north and westward.

** *Tendrils present; stipules narrow, semi-sagittate, acuminate.*

† *Flowers purple; leaflets several pairs.*

3. **L. palustris,** L. *Slender,* glabrous or somewhat pubescent; stem often winged; stipules lanceolate, sharp-pointed at both ends; *leaflets 2–4 pairs, narrowly oblong to linear, acute* (1–2′ long); *peduncles 2–6-flowered;* flowers 6″ long.—Moist places, Lab. and N. Scotia, westward across the continent. (Eu.)

11. APIOS, Boerhaave. Ground-nut. Wild Bean.

Calyx somewhat 2-lipped, the 2 lateral teeth being nearly obsolete, the upper very short, the lower one longest. Standard very broad, reflexed; the long scythe-shaped keel strongly incurved, at length coiled. Stamens diadelphous. Pod straight or slightly curved, linear, elongated, thickish, many-seeded.—A perennial herb (with some milky juice!), twining and climbing over bushes, and bearing edible tubers on underground shoots. Leaflets 3-7, ovate-lanceolate, obscurely stipellate. Flowers in dense and short, often branching racemes. (Name from ἄπιον, *a pear,* from the shape of the tubers.)

1. **A. tuberosa,** Moench. Flowers brown-purple or chocolate color, violet-scented.—Low grounds, N. Brunswick to Ont., west to Minn., Kan., and La.

12. AMPHICARPÆA, Ell. Hog Pea-nut.

Flowers of 2 kinds; those of the racemes from the upper branches perfect, but seldom ripening fruit; those near the base and on filiform creeping branches with the corolla none or rudimentary, and few free stamens, but fruitful. Calyx about equally 4- (rarely 5) toothed; bractlets none or minute. Keel and wing-petals similar, almost straight; the standard partly folded round them. Stamens diadelphous. Style beardless. Pods of the upper flowers, when formed, somewhat scymetar-shaped, stipitate, 3–4-seeded; of the lower ones commonly subterranean and fleshy, obovate or pear-shaped, ripening usually but one large seed.—Low and slender

perennials; the twining stems clothed with brownish hairs. Leaves pinnately 3-foliolate; leaflets rhombic-ovate, stipellate. Flowers in simple or compound racemes, purplish. Bracts persistent, round, partly clasping, striate, as well as the stipules. (Name from ἀμφί, *both*, and καρπός, *fruit*, in allusion to the two kinds of pods.)

1. **A. monoica**, Nutt. Leaflets thin, ½–2′ long; racemes nodding; calyx of upper flowers 2″ long, the ovary glabrous except the hairy margin; pod 1′ long; ovary and pod of the rudimentary flowers hairy.—Rich damp woodlands, common. Aug., Sept.

ORDER 26. ROSACEÆ (ROSE FAMILY).

Plants with regular flowers, numerous (rarely few) distinct stamens inserted on the calyx, and 1–many pistils, which are quite distinct, or (in the last tribe) united and combined with the calyx-tube. Seeds (anatropous) 1–few in each ovary, almost always without albumen. Embryo straight, with large and thick cotyledons. Leaves alternate, with stipules, these sometimes caducous, rarely obsolete or wanting. —Calyx of 5 or rarely 3–4–8 sepals (the odd one superior), united at the base, often appearing double by a row of bractlets outside. Petals as many as the sepals (rarely wanting), mostly imbricated in the bud, and inserted with the stamens on the edge of a disk that lines the calyx-tube. Trees, shrubs, or herbs.—A large and important order, almost destitute of noxious qualities, and producing the most valuable fruits. Very intimately connected with Leguminosæ on one hand, and with Saxifragaceæ on the other.

I. Ovary superior and not enclosed in the calyx-tube at maturity.

* Calyx deciduous, without bractlets; pistil solitary, becoming a drupe.

Tribe I. PRUNEÆ. Trees or shrubs, with simple mostly serrate leaves. Ovules 2, pendulous, but seed almost always solitary. Style terminal.

1. **Prunus.** Flowers perfect. Lobes of calyx and corolla 5. Stone of the drupe bony.

* * Calyx mostly persistent; pistils few to many (rarely solitary).

† Calyx without bractlets; ovules 2–many.

Tribe II. SPIRÆEÆ. Pistils mostly 5, becoming 2–several-seeded follicles. Shrubs or perennial herbs.

a. Calyx short, 5-cleft. Petals obovate, equal.

2. **Spiræa.** Flowers perfect or diœcious. Pods 1-valved. Herbs or shrubs; leaves simple or pinnate.

3. **Physocarpus.** Pods inflated, 2-valved. Shrub; leaves palmately lobed.

b. **Calyx elongated, 5-toothed. Petals slender, unequal.**

Tribe III. RUBEÆ. Pistils several or numerous, becoming drupelets in fruit. Ovules 2 and pendulous, but seed solitary. Perennials, herbaceous or with biennial soft-woody stems.

4. **Rubus.** Pistils numerous, fleshy in fruit, crowded upon a spongy receptacle.

5. **Dalibarda.** Pistils 5–10, in the bottom of the calyx, nearly dry in fruit.

† † Calyx-lobes mostly with bractlets; ovule solitary.

Tribe IV. POTENTILLEÆ. Pistils few-many, 1-ovuled, becoming dry achenes. Herbs.

a. Styles persistent and elongated after anthesis, often plumose or jointed.

6. **Geum.** Calyx-lobes usually with 5 alternating small bractlets. Stamens and carpels numerous; styles becoming plumose or hairy tails, or naked and straight or jointed.

b. Styles not elongated after anthesis, mostly deciduous.

7. **Fragaria.** Flower as in Potentilla. Receptacle much enlarged and pulpy in fruit.

8. **Potentilla.** Petals 5 (rarely 4), conspicuous. Calyx-lobes as many, with an alternating set of bractlets. Stamens and achenes numerous; the latter heaped on a dry receptacle. Styles commonly more or less lateral, deciduous or not enlarging in fruit.

II. Ovaries inferior or enclosed in the calyx-tube.

Tribe V. POTERIEÆ. Pistils 1–4, becoming achenes, completely enclosed in the dry and firm calyx-tube, which is constricted or nearly closed at the throat. Herbs with compound or lobed leaves. Petals often none.

9. **Agrimonia.** Calyx turbinate, with a margin of hooked prickles. Stamens 5–12. Flowers yellow, in long racemes.

10. **Poterium.** Calyx-lobes petaloid; tube 4-angled, naked. Petals none. Flowers densely capitate or spicate.

Tribe VI. ROSEÆ. Pistils many, becoming bony achenes, enclosed in the globose or urn-shaped fleshy calyx-tube, which resembles a pome. Petals conspicuous. Stamens numerous.

11. **Rosa.** The only genus. Prickly shrubs with pinnate leaves.

Tribe VII. POMEÆ. Carpels 2–5, enclosed in and coalescent with the fleshy or berry-like calyx, in fruit becoming a 2–several-celled pome. Trees or shrubs, with stipules free from the petiole.

a. Cells of the compound ovary as many as the styles (2–5), each 2- (rarely several) ovuled.

12. **Pyrus.** Pome containing 2–5 papery or cartilaginous carpels.

13. **Cratægus.** Pome drupe-like, with 1–5 bony stones or kernels. Usually thorny.

b. Cells of the compound ovary becoming twice as many as the styles, each 1-ovuled.

14. **Amelanchier.** Pome usually of 5 carpels; each becomes incompletely 2-celled by a projection from its back; otherwise as Pyrus.

1. PRUNUS, Tourn. PLUM, CHERRY, ETC.

Calyx 5-cleft; the tube bell-shaped, urn-shaped or tubular-obconical, deciduous after flowering. Petals 5, spreading. Stamens 15–20. Pistil solitary, with 2 pendulous ovules. Drupe fleshy, with a bony stone.—Small trees or shrubs, with mostly edible fruit. (The ancient Latin name.)

§ 1. PRUNUS proper (and CERASUS). *Drupe smooth, and the stone smooth or somewhat rugged; flowers (usually white) from separate lateral scaly buds in early spring, preceding or coetaneous with the leaves; the pedicels few or several in simple umbel-like clusters.*

1. **P. Americana,** Marshall. WILD YELLOW OR RED PLUM. Tree thorny, 8–20° high; *leaves ovate* or somewhat obovate, *conspicuously pointed, coarsely or doubly serrate, very veiny, glabrous when mature;* fruit nearly destitute of bloom, roundish-oval, yellow, orange, or red, $\frac{1}{2}$–$\frac{2}{3}$′ in diameter, with the turgid stone more or less acute on both margins, or in cultivated states 1′ or more in diameter, the flattened stone with broader margins; pleasant-tasted, but with a tough and acerb skin.—Woodlands and river banks, common.

2. **P. Pennsylvanica,** L. f. WILD RED CHERRY. Tree 20–30° high, with light red-brown bark; *leaves oblong lanceolate, pointed, finely and sharply serrate, shining, green and smooth both sides;* flowers many in a cluster, on long pedicels; fruit globose, light red, very small, with thin and sour flesh; stone globular.—Rocky woods, Newf., and westward.

§ 2. PADUS. *Drupe small, globose, without bloom; the stone turgid-ovate, marginless; flowers in racemes terminating leafy branches, therefore appearing after the leaves, late in spring.*

3. **P. Virginiana,** L. CHOKE-CHERRY. A tall shrub, with grayish bark; *leaves oval, oblong, or obovate, abruptly pointed, very sharply (often doubly) serrate with slender teeth,* thin; petals roundish; fruit red, turning to dark crimson; stone smooth.—River banks, Newf., westward.—Fruit very austere and astringent. A variety with very short dense racemes and sweeter yellowish fruit has been found at Dedham, Mass.

4. **P. serotina,** Ehrh. WILD BLACK CHERRY. A large tree, with reddish-brown branches; *leaves oblong or lanceolate-oblong, taper-pointed, serrate with incurved short and callous teeth,* thickish, shining above; racemes elongated; petals obovate; fruit purplish-black.—Woods, N. S. to Ont., west to Minn., E. Neb., and La.—Fruit slightly bitter, but with a pleasant vinous flavor.

2. SPIRÆA, L. MEADOW-SWEET.

Calyx 5-cleft, short, persistent. Petals 5, obovate, equal, imbricated in the bud. Stamens 10–50. Pods (follicles) 5–8, not inflated, few–several-seeded. Seeds linear, with a thin or loose coat and no albumen.—Shrubs or perennial herbs, with simple or pinnate leaves, and white or rose-colored flowers in corymbs or panicles. (The Greek name from *σπειράω, to twist,* from the twisting of the pods in the original species.)

§ 1. SPIRÆA proper. *Erect shrubs, with simple leaves; stipules obsolete; pods mostly* 5, *several-seeded.*

1. **S. salicifolia,** L. COMMON MEADOW-SWEET. *Nearly smooth* (2–3° high); leaves wedge-lanceolate, simply or doubly-serrate; *flowers in a crowded panicle,* white or flesh color; pods smooth.—Wet or low grounds, Newf., westward.

2. **S. tomentosa,** L. HARDHACK. STEEPLE-BUSH. *Stems and lower surface of the* ovate or oblong serrate *leaves very woolly;* flowers in short racemes crowded in a dense panicle, rose color, rarely white; pods woolly.—Low grounds, N. Scotia to Ont.

3. PHYSOCARPUS, Maxim. NINE-BARK.

Carpels 1–5, inflated, 2-valved; ovules 2–4. Seeds roundish, with a smooth and shining crustaceous testa and copious albumen. Stamens 30–40. Otherwise as Spiræa.—Shrubs, with simple palmately-lobed leaves and umbel-like corymbs of white flowers. (Name from *φῦσα, a bladder,* and *καρπός, fruit.*)

1. **P. opulifolius,** Maxim. Shrub 4–10° high, with long recurved branches, the old bark loose and separating in numerous thin layers; leaves roundish, somewhat 3-lobed and heart-shaped; the purplish membranaceous pods very conspicuous. (Spiræa opulifolia, *L.* Neillia opulifolia, *Benth. and Hook.*)—Rocky banks of

streams, P. Q., Ont., and west to the Pacific northward. Often cultivated.

4. RUBUS, Tourn. Bramble.

Calyx 5-parted, without bractlets. Petals 5, deciduous. Stamens numerous. Achenes usually many, collected on a spongy or succulent receptacle, becoming small drupes; styles nearly terminal. —Perennial herbs, or somewhat shrubby plants, with white (rarely reddish) flowers, and edible fruit. (The Roman name, kindred with *ruber*, red.)

§ 1. *Fruit, or collective mass of drupes, falling off whole from the dry receptacle when ripe, or of few grains which fall separately.*—Raspberry.

* *Leaves simple; flowers large; prickles none; fruit and receptacle flat and broad.*

1. **R. odoratus**, L. Purple Flowering-Raspberry. *Stem shrubby* (3–5° high); *branches, stalks, and calyx bristly with glandular clammy hairs;* leaves 3–5 lobed, the lobes pointed and minutely toothed, the middle one prolonged; peduncles many-flowered; flowers showy (2′ broad); calyx-lobes tipped with a long narrow appendage; *petals rounded, purple rose color;* fruit reddish.—N. S. to Ont., west to Mich.

* * *Leaflets (pinnately or pedately) 3–5; petals small, erect, white.*

† *Stems annual, herbaceous, not prickly; fruit of few separate grains.*

2. **R. triflorus**, Richardson. Dwarf Raspberry. Stems ascending (6–12′ high) or trailing; leaflets 3 (or pedately 5), rhombic-ovate or ovate-lanceolate, acute at both ends, coarsely doubly serrate, thin, smooth; peduncle 1–3-flowered.—Wooded hillsides, Lab. to the Pacific. Sepals and petals often 6 or 7. This appears to be more properly a blackberry.

† † *Stems biennial and woody, prickly; receptacle oblong; fruit hemispherical.*

3. **R. strigosus**, Michx. Wild Red Raspberry. *Stems upright*, and with the stalks, etc., *beset with stiff straight bristles* (or a few becoming weak hooked prickles), glandular when young, somewhat glaucous; leaflets 3–5, oblong-ovate, pointed, cut-serrate,

whitish-downy underneath, the lateral ones sessile; petals as long as the sepals; *fruit light red.*—Thickets and hills. Lab. to the R. Mts.

4. **R. occidentalis,** L. Black Raspberry. Thimbleberry. *Glaucous all over; stems recurved, armed* like the stalks, etc., *with hooked prickles, not bristly;* leaflets 3 (rarely 5), ovate, pointed, coarsely doubly serrate, whitened-downy underneath, the lateral ones somewhat stalked; petals shorter than the sepals; *fruit purple-black* (rarely a whitish variety), ripe early in July. Common, N.B. to Ont.—An apparent hybrid (R. neglectus, *Peck*) between this and the last species occurs, with characters intermediate between the two, and growing with them.

§ 2. *Fruit, or collective drupes, not separating from the juicy prolonged receptacle, mostly ovate or oblong, blackish; stems prickly and flowers white.*—Blackberry.

5. **R. villosus,** Ait. Common or High Blackberry. Shrubby (1–6° high), furrowed, *upright or reclining, armed with stout curved prickles;* branchlets, stalks, and lower surface of the leaves *hairy and glandular;* leaflets 3 (or pedately 5), ovate, pointed, unequally serrate, the terminal ones somewhat heart-shaped, conspicuously stalked; *flowers racemed, numerous;* bracts short; sepals linear-pointed, much shorter than the obovate-oblong spreading petals.—Borders of thickets, etc., common, N.S. westward, and very variable in size, aspect, and shape of fruit.

6. **R. Canadensis,** L. Low Blackberry. Dewberry. *Shrubby, extensively trailing, slightly prickly;* leaflets 3 (or pedately 5–7), oval or ovate-lanceolate, mostly pointed, thin, *nearly smooth,* sharply cut-serrate; flowers racemed, with leaf-like bracts.—Dry fields, common; Newf., Ont., west to Central Minn. and E. Kan.

7. **R. hispidus,** L. Running Swamp-Blackberry. *Stems slender, scarcely woody, extensively procumbent, beset with small reflexed prickles;* leaflets 3 (or rarely pedately 5), *smooth, thickish, mostly persistent,* obovate, obtuse, coarsely serrate, entire toward the base; *peduncles leafless, several-flowered, often bristly; flowers small;* fruit of few grains, black.—In low woods or swampy grassy ground, N. Scotia to Ont.

5. DALIBARDA, L.

Calyx deeply 5–6-parted, 3 of the divisions larger and toothed. Petals 5, sessile, deciduous. Stamens many. Ovaries 5–10, becoming nearly dry seed-like drupes; styles terminal, deciduous.—Low perennials, with creeping and densely tufted stems or rootstocks, and roundish-heart-shaped crenate leaves on slender petioles. Flowers 1 or 2, white, on scape-like peduncles. (Named in honor of *Thomas Dalibard*, a French botanist of the time of Linnæus.)

1. **D. repens**, L. Downy; sepals spreading in the flower, converging and enclosing the fruit.—Wooded banks; N.S. to Ont. June–Aug.—In aspect and foliage resembling a stemless Violet.

6. GEUM, L. AVENS.

Calyx bell-shaped or flattish, deeply 5-cleft, usually with 5 small bractlets at the sinuses. Petals 5. Stamens many. Achenes numerous, heaped on a conical or cylindrical dry receptacle, the long persistent styles forming hairy or naked and straight or jointed tails. Seed erect; radicle inferior.—Perennial herbs, with pinnate or lyrate leaves. (A name used by Pliny, of unknown meaning.)

§ 1. GEUM proper. *Styles jointed and bent near the middle, the upper part deciduous and mostly hairy, the lower naked and hooked, becoming elongated; head of fruit sessile in the calyx; calyx-lobes reflexed.*

* *Petals white or pale greenish-yellow, small, spatulate or oblong; stipules small.*

1. **G. album**, Gmelin. *Smoothish or softly pubescent; stem slender* (2° high); root-leaves of 3–5 leaflets, or simple and rounded, with a few minute leaflets on the petiole below; those of the stem 3-divided or lobed, or only toothed; hairs upon the long slender peduncles ascending or spreading; *receptacle of the fruit densely bristly-hirsute.*—Borders of woods, etc.; common. May–Aug.

** *Petals golden-yellow, conspicuous, broadly-obovate, exceeding the calyx; stipules larger and all deeply cut.*

2. **G. macrophyllum**, Willd. Bristly-hairy, stout (1–3° high); root-leaves lyrately and interruptedly pinnate, with the *terminal leaflet very large and round-heart-shaped;* lateral leaflets of the stem-leaves 2–4, minute, the terminal roundish, 3-cleft, the *lobes*

wedge-form and rounded; receptacle nearly naked.—N. Scotia and N. Eng. to Minn., Mo., and westward. June. (Eu.)

3. **G. strictum,** Ait. Somewhat hairy (3–5° high); root-leaves interruptedly pinnate, the leaflets wedge-obovate; *leaflets of the stem-leaves 3–5, rhombic-ovate or oblong, acute; receptacle downy.*—Moist meadows, Newf. and westward. July, Aug. (Eu.)

§ 2. CARYOPHYLLATA. *Style jointed and bent in the middle, the upper joint plumose; flowers large; calyx erect or spreading; petals erect.*

4. **G. rivale,** L. Water, or Purple Avens. Stems nearly simple, several-flowered (2° high); root-leaves lyrate and interruptedly pinnate, those of the stem few, 3-foliolate or 3-lobed; petals dilated-obovate, retuse, contracted into a claw, purplish-orange; head of fruit stalked in the brown-purple calyx.—Bogs and wet meadows, Newf. and westward.—Flowers nodding; pedicels erect in fruit. (Eu.)

7. FRAGARIA, Tourn. Strawberry.

Flowers nearly as in Potentilla. Styles deeply lateral. Receptacle in fruit much enlarged and conical, becoming pulpy and scarlet, bearing the minute dry achenes scattered over its surface.—Stemless perennials, with runners, and with white cymose flowers on scapes. Leaves radical; leaflets 3, obovate-wedge-form, coarsely serrate; stipules cohering with the base of the petioles, which with the scapes are usually hairy. (Name from the fragrance of the fruit.)—Flowering in spring. (The species are indiscriminately called Wild Strawberry.)

1. **F. Virginiana,** Mill. *Achenes imbedded in the deeply pitted fruiting receptacle,* which usually has a narrow neck; calyx becoming erect after flowering and connivent over the hairy receptacle when sterile or unfructified; *leaflets of a firm or coriaceous texture; the hairs of the scapes,* and especially of the *pedicels, silky and appressed.*—Moist or rich woodlands, fields, etc.; common.

2. **F. vesca,** L. *Achenes superficial on the glabrous conical or hemispherical fruiting receptacle* (not sunk in pits); calyx remaining spreading or reflexed; hairs on the scape mostly widely spreading, on the pedicels appressed; *leaflets thin,* even the upper face strongly

marked by the veins.—Fields and rocky places; less common. (Eu.)

8. POTENTILLA, L. Cinque-foil. Five-finger.

Calyx flat, deeply 5-cleft, with as many bractlets at the sinuses, thus appearing 10-cleft. Petals 5, usually roundish. Stamens many. Achenes many, collected in a head on the dry mostly pubescent or hairy receptacle; styles lateral or terminal, deciduous. Radicle superior.—Herbs, or rarely shrubs, with compound leaves, and solitary or cymose flowers; their parts rarely in fours. (Name a diminutive from *potens*, powerful, originally applied to P. Anserina, from its once reputed medicinal powers.)

§ 1. *Styles thickened and glandular toward the base; achenes glabrous, numerous; inflorescence cymose.*

* *Style terminal; flowers small, yellow; leaves pinnate or ternate.*

† *Annual or biennial; leaflets incisely serrate, not white-tomentose; stamens 5–20.*

1. **P. Norvegica,** L. *Stout, erect, hirsute* (½–2° high; *leaves ternate;* leaflets obovate or oblong-lanceolate; *cyme, rather close,* leafy; *calyx large;* stamens 15 (rarely 20).—Lab. westward. (Eu.)

§ 2. *Styles filiform, not glandular at base; inflorescence cymose.*

* *Style terminal; achenes glabrous; stamens 20; herbaceous perennials, with rather large yellow flowers.*

† *Leaves palmate, of 3 or 5 leaflets; tomentose or villous.*

2. **P. argentea,** L. Silvery Cinque-foil. Stems ascending, paniculately branched at the summit, many-flowered, white-woolly; leaflets 5, wedge-oblong, almost pinnatifid, entire toward the base, with revolute margins, green above, white with silvery wool beneath.—Dry barren fields, etc., N. Scotia to Ont. June–Sept. (Eu.)

** *Style lateral; purple petals (shorter than the broad calyx) somewhat persistent; disk thick and hairy; achenes glabrous; hairy receptacle becoming large and spongy.*

3. **P. palustris,** Scop. Marsh Five-Finger. Stems stout, ascending from a decumbent rooting perennial base (½–2° long), glabrous below; leaves pinnate; leaflets 5–7, oblong, serrate,

lighter colored and more or less pubescent beneath ; flowers few in an open cyme ; calyx (1′ broad) dark purple inside.—Lab. to the Pacific. (Eu.)

*** *Style attached below the middle; achenes and receptacle densely villous; woody perennials.*

4. **P. fruticosa**, L. Shrubby Cinque-foil. *Stem erect, shrubby* (1–4° high), much branched ; *leaves pinnate* ; *leaflets* 5–7, crowded, oblong-lanceolate, *entire*, silky, usually whiter beneath and the margins revolute ; *petals yellow, orbicular.*—Wet grounds, Lab. north and westward to the Pacific. June–Sept. (Eu.)

5. **P. tridentata**, Ait. Three-toothed C. Stems low (1–10′ high), rather woody at base, tufted, ascending, cymosely several-flowered ; *leaves palmate ; leaflets* 3, wedge-oblong, nearly smooth, thick, *coarsely 3-toothed at the apex ; petals white ;* achenes and receptacle very hairy.—Lab. north and westward.

§ 3. *Style filiform, lateral ; peduncles axillary, solitary, 1-flowered ; achenes glabrous ; receptacle very villous ; herbaceous perennials, with yellow flowers.*

6. **P. Anserina**, L. Silver-Weed. *Spreading by slender many-jointed runners, white-tomentose and silky-villous ; leaves all radical, pinnate ;* leaflets 7–21, with smaller ones interposed, *oblong*, sharply serrate, silky tomentose at least beneath ; bractlets and stipules often incisely cleft ; peduncles elongated.—Brackish marshes and river banks. (Eu.)

7. **P. Canadensis**, L. Common Cinque-foil or Five-Finger. *Stems slender and decumbent or prostrate*, or sometimes erect ; *pubescence villous, often scanty ; leaves ternate, but apparently quinate* by the parting of the lateral leaflets ; *leaflets cuneate-oblong or obovate*, incisely serrate, nearly glabrous above ; bractlets entire.—Dry soil ; N. S. to Ont. Common and variable. Apr.–July.—Often producing summer runners.

9. AGRIMONIA, Tourn. Agrimony.

Calyx-tube top-shaped, contracted at the throat, beset with hooked bristles above, indurated in fruit and enclosing the 2 achenes ; the limb 5-cleft, closed after flowering. Petals 5. Stamens 5–15. Styles terminal. Seed suspended.—Perennial

herbs, with interruptedly pinnate leaves, and yellow flowers in slender spiked racemes; bracts 3-cleft. (Name a corruption of *Argemonia.*)

1. **A. Eupatoria**, L. COMMON AGRIMONY. *Leaflets* 5–7 *with minute ones intermixed, oblong-obovate*, coarsely toothed; petals twice the length of the calyx.—Borders of woods, common. July–Sept. (Eu.)

10. POTERIUM, L. BURNET.

Calyx with a top-shaped tube, constricted at the throat, persistent; the 4 broad petal-like spreading lobes imbricated in the bud, deciduous. Petals none. Stamens 4–12 or more, with flaccid filaments and short anthers. Pistils 1–3; the slender terminal style tipped with a tufted or brush-like stigma. Achene (commonly solitary) enclosed in the 4-angled dry and thickish closed calyx-tube. Seed suspended.—Chiefly perennial herbs, with unequally pinnate leaves, stipules coherent with the petiole, and small, often polygamous or diœcious flowers crowded in a dense head or spike at the summit of a long and naked peduncle, each bracteate and 2-bracteolate. (Name ποτήριον, *a drinking cup*, the foliage of Burnet having been used in the preparation of some medicinal drink.)

1. **P. Canadense**, Benth. and Hook. CANADIAN BURNET. Stamens 4, long-exserted, club-shaped, white, as is the whole of the elongated and cylindrical spike; stem 3–6° high; leaflets numerous, ovate or oblong-lanceolate, coarsely serrate, obtuse, heart-shaped at base, as if stipellate; stipules serrate.—Bogs and wet meadows, Newf. west and northward.

11. ROSA, Tourn. ROSE.

Calyx-tube urn-shaped, contracted at the mouth, becoming fleshy in fruit. Petals 5, obovate or obcordate, inserted with the many stamens into the edge of the hollow thin disk that lines the calyx-tube and within bears the numerous pistils below. Ovaries hairy, becoming bony achenes in fruit.—Shrubby and usually spiny or prickly, with odd-pinnate leaves, and stipules cohering with the petiole; stalks, foliage, etc., often bearing aromatic glands. Many of the species are very variable in their characters, and are often indeterminable upon imperfect specimens. (The ancient Latin name.)

* *Styles distinct; sepals connivent after flowering and persistent; pedicels and receptacles naked.*

† *Fruit globose; infrastipular spines none; acicular prickles often present.*

1. **R. blanda**, Ait. Stems 1–3° high, *wholly unarmed* (occasionally with a few or very rarely numerous prickles); *stipules dilated*, naked and entire, or slightly glandular-toothed; *leaflets* 5–7, usually oblong-lanceolate, *cuneate at base and petiolulate, simply serrate, not resinous;* flowers usually large, corymbose or solitary; *sepals hispid, entire.*—On rocks and rocky shores, Newf. westward.

** *Styles distinct; sepals spreading after flowering and deciduous; infrastipular spines usually present, often with scattered prickles; sepals, globose receptacle, and pedicel usually hispid; teeth simple; pubescence not resinous.*

† *Leaflets mostly finely many toothed.*

2. **R. Carolina**, L. Stems usually tall (1–7° high), with stout straight or usually more or less curved spines; stipules long and very narrow; leaflets dull green, 5–9 (usually 7), usually narrowly oblong and acute at each end and petiolulate, but often broader, usually pubescent beneath.—Borders of swamps and streams, N. S. to Ont., and westward.

† † *Leaflets coarsely toothed.*

3. **R. lucida**, Ehrh. Stems often tall and stout (a few inches to 6° high), *with at length stout and usually more or less hooked spines; stipules* usually naked, *more or less dilated; leaflets* (mostly 7) dark green, rather thick, *smooth and often shining above;* flowers corymbose or solitary; outer sepals frequently with 1 or 2 small lobes.—Margins of swamps or moist places. Newf. to Ont.

Naturalized species.

4. **R. rubiginosa**, L. Sweetbrier. Eglantine. *Leaflets densely resinous beneath and aromatic, and doubly serrate;* the short pedicels and pinnatifid sepals hispid. (Incl. R. micrantha, *Smith;* less aromatic, with oblong fruit and glabrous styles.)—N. Scotia and Ont. to S. C. and Tenn. (Int. from Eu.)

12. PYRUS, L. PEAR. APPLE.

Calyx-tube urn-shaped, the limb 5-cleft. Petals roundish or obovate. Stamens numerous. Styles 2–5. Pome fleshy or berry-like; the 2–5 carpels or cells of a papery or cartilaginous texture, 2-seeded.—Trees or shrubs, with handsome flowers in corymbed cymes. (The classical name of the Pear tree.)

§ 1. ADENORHACHIS. *Leaves simple, the midrib glandular along the upper side; cymes compound; styles united at base; fruit berry-like, small.*

1. **P. arbutifolia**, L. f. CHOKE-BERRY. A shrub usually 1–3° high; leaves oblong or oblanceolate, mostly acute or acuminate, finely glandular-serrate, tomentose beneath; cyme tomentose; flowers white or reddish; fruit pear-shaped, or globose when ripe, small, red or purple, astringent.—Swamps and damp thickets; common, from N. Scotia to Q., Ont., and west to Minn., Ill., Mo., and La.

Var. **melanocarpa**, Hook. Nearly smooth throughout, with larger black fruit; leaves usually less acute.—Of apparently the same range.

§ 2. SORBUS. *Leaves odd-pinnate, with rather numerous leaflets; cymes compound; styles separate; pome berry-like, small.*

2. **P. Americana**, DC. AMERICAN MOUNTAIN-ASH. Tree or tall shrub, *nearly glabrous* or soon becoming so; *leaflets* 13–15, *lanceolate, taper-pointed*, sharply serrate with pointed teeth, bright green; cymes large and flat; berries globose, bright red, not larger than peas; *leaf-buds pointed, glabrous* and somewhat *glutinous*.—Swamps and mountain-woods, Newf., westward. Often cultivated.

3. **P. sambucifolia**, Cham. and Schlecht. *Leaflets oblong, oval, or lanceovate, mostly obtuse* or abruptly short-pointed, serrate (mostly doubly) with more spreading teeth, often pale beneath; cymes smaller; flowers and berries larger, the latter (4″ broad) when young ovoid, at length globose; *leaf-buds sparingly hairy;* otherwise nearly as the preceding.—Lab. to northern N. Eng. and Lake Superior, and westward.

13. CRATÆGUS, L. Hawthorn. White Thorn.

Calyx-tube urn-shaped, the limb 5-cleft. Petals 5, roundish. Stamens many, or only 10–5. Styles 1–5. Pome drupe-like, containing 1–5 bony 1-seeded stones.—Thorny shrubs or small trees, with simple and mostly lobed leaves, and white (rarely rose-colored) blossoms. (Name from κράτος, *strength*, on account of the hardness of the wood.)

* *Corymbs many-flowered.*

† *Fruit large* (½–1′ *long*), *red; flowers large; styles and stones even in the same species* 1–3 (*when the fruit is ovoid or pear-shaped*) *or* 4–5 (*in globular fruit*); *stipules, calyx-teeth, bracts, etc., often beset with glands; shrubs or low trees.* [Species as characterized by Prof. C. S. Sargent.]

1. **C. coccinea,** L. Branches reddish; spines stout, chestnut-brown; villous-pubescent on the shoots, glandular peduncles, and calyx; leaves on slender petioles, thin, pubescent beneath or often glabrous, round-ovate, cuneate or subcordate at base, acutely glandular-toothed, sometimes cut-lobed; flowers [illegible] broad; fruit coral-red, globose or obovate, ½′ broad.—Newf. westward.

2. **C. tomentosa,** L. Branches gray, rarely with stout gray spines; shoots, peduncles, and calyx villous-pubescent; glands none; leaves large, pale, prominently veined, densely pubescent beneath, ovate or ovate-oblong, sharply serrate, usually incisely lobed, contracted into a margined petiole; flowers small, ill-scented; fruit dull red, obovate, rarely globose (½′ broad), upright.—N. S. to Ont. In flower 2–3 weeks after n. 1.

3. **C. punctata,** Jacq. Branches horizontal; glands none; leaves smaller, mostly wedge-obovate, attenuate and entire below, unequally toothed above, rarely lobed, villous-pubescent becoming smooth but dull, the many veins more impressed, prominent beneath; fruit globose (1′ broad), red or bright yellow. (C. tomentosa, var. punctata, *Gray.*)—Quebec to Ont. and south to Ga.

4. **C. Crus-galli,** L. Cockspur Thorn. Branches horizontal, with slender thorns often 4′ long; *glabrous; leaves thick,* dark green, *shining above, wedge-obovate and oblanceolate,* tapering into a very short petiole, serrate above the middle; fruit globular, dull red (⅓′ broad).—Thickets, common. Ont.

14. AMELANCHIER, Medic. JUNE-BERRY.

Calyx 5-cleft; lobes downy within. Petals oblong, elongated. Stamens numerous, short. Styles 5, united below. Ovary 5-celled, each cell 2-ovuled, but a projection grows from the back of each and forms a false cartilaginous partition; the berry-like pome thus 10-celled, with one seed in each cell (when all ripen).—Small trees or shrubs, with simple sharply serrated leaves, and white racemose flowers. (*Amelancier* is the name of A. vulgaris in Savoy.)

1. **A. Canadensis**, Torr. and Gray. SHAD-BUSH. SERVICE-BERRY. A tree 10–30° high, nearly or soon glabrous; leaves ovate to ovate-oblong, usually somewhat cordate at base, pointed, very sharply serrate, 1–3½′ long; bracts and stipules very long silky-ciliate; flowers large, in drooping nearly glabrous racemes; petals oblong, 6–8″ long; fruit on elongated pedicels, globose, crimson or purplish, sweet and edible. (Var. Botryapium, *Torr. and Gray.*)—Dry open woodlands; Newf. and Ont. Fruit ripening in June. Var. ROTUNDIFOLIA (Torr. and Gray), appears to be only a broad-leaved form.

Var. (?) **oblongifolia**, Torr. and Gray. A smaller tree or shrub (6–10° high), the young leaves and racemes densely white-tomentose; leaves oblong or sometimes rather broadly elliptical, acute, mostly rounded at base, finely serrate, 1–2′ long; flowers in denser and shorter racemes; petals 3–4″ long, oblong-spatulate; fruit similar but more juicy, on shorter pedicels.—Low moist grounds or swampy woods; N. S., westward.

ORDER 27. SAXIFRAGACEÆ (SAXIFRAGE FAMILY).

Herbs or shrubs, of various aspect, distinguishable from Rosaceæ *by having copious albumen in the seeds, opposite as well as alternate leaves, and usually no stipules, the stamens mostly definite, and the carpels commonly fewer than the sepals*, either separate or partly so, or all combined into one compound pistil. Calyx either free or adherent, usually persistent or withering away. Stamens and petals almost always inserted on the calyx. Ovules anatropous.

Tribe I. SAXIFRAGEÆ. Herbs. Leaves alternate (rarely opposite in n. 3). Fruit dry, capsular or follicular, the styles or tips of the carpels distinct.

* Ovary 2- (rarely 3) celled with axile placentas, or of as many nearly distinct carpels.

1. **Saxifraga.** Flowers perfect. Petals 5. Stamens 10. Seeds numerous, with a close coat.

* * Ovary 1-celled, with 2 parietal placentas alternate with the stigmas. Sterile stamens none.

2. **Tiarella.** Calyx nearly free from the slender ovary. Petals entire. Stamens 10. Placentas nearly basal.

3. **Mitella.** Calyx partly cohering with the depressed ovary. Petals small, pinnatifid. Stamens 10.

4. **Chrysosplenium.** Calyx-tube coherent with the ovary. Petals none. Stamens 10.

* * * Ovary 1-celled, with 3–4 parietal placentas opposite the sessile stigmas. A cluster of united sterile filaments at the base of each petal.

5. **Parnassia.** Sepals, petals and proper stamens 5. Peduncle scape-like, 1-flowered.

Tribe II. RIBESIEÆ. Shrubs. Leaves alternate and simple, with stipules adnate to the petiole or wanting. Fruit a berry.

6. **Ribes.** Calyx-tube adnate to the 1-celled ovary. Placentas 2, parietal, many-seeded.

1. SAXIFRAGA, L. Saxifrage.

Calyx either free from or cohering with the base of the ovary, 5-cleft or parted. Petals 5, entire, imbricated in the bud, commonly deciduous. Stamens 10. Styles 2. Capsule 2-beaked, 2-celled, opening down or between the beaks, or sometimes 2 almost separate follicles. Seeds numerous, with a close coat.—Chiefly perennial herbs, with the root-leaves clustered, those of the stem mostly alternate. (Name from *saxum*, a rock, and *frango*, to break; many species rooting in the clefts of rocks.)

* *Stems ascending; leaves alternate; calyx coherent below with the capsule.*

1. **S. aizoides,** L. Yellow Mountain-S. Low (3–5′ high), in tufts, with few or several corymbose flowers; *leaves linear-lanceolate, entire, fleshy,* distantly spinulose-ciliate; *petals yellow, spotted with orange, oblong.*—Lab. and Anticosti, west to R. Mts.

* * *Leaves clustered at the root; scape many-flowered, erect, clammy-pubescent.*

† *Petals all alike.*

2. **S. Aizoon,** Jacq. Scape 5–10′ high; *leaves persistent, thick, spatulate, with white cartilaginous toothed margins;* calyx partly adherent; petals obovate, cream-color, often spotted at the base.—Moist rocks, Lab. west, and northward. (Eu.)

3. **S. Virginiensis**, Michx. EARLY S. Low (4–9′ high); *leaves obovate or oval spatulate*, narrowed into a broad petiole, crenate-toothed, thickish; flowers in a clustered cyme, which is at length open and loosely panicled; lobes of the nearly free *calyx erect, not half the length of the oblong obtuse* (*white*) *petals;* follicles united merely at the base, divergent, purplish.—Exposed rocks and dry hillsides; N. Brunswick, westward, common. April–June.

2. TIARELLA, L. FALSE MITRE-WORT.

Calyx bell-shaped, nearly free from the ovary, 5-parted. Petals 5, with claws, entire. Stamens 10, long and slender. Styles 2. Capsule membranaceous, 1-celled, 2-valved; the valves unequal. Seeds few, at the base of each parietal placenta, globular, smooth.—Perennials; flowers white. (Name a diminutive from *τιάρα, a tiara,* or turban, from the form of the pod, or rather pistil, which is like that of Mitella, to which the name of *Mitre-wort* properly belongs.)

1. **T. cordifolia**, L. Leaves from the rootstock or summer runners heart-shaped, sharply lobed and toothed, sparsely hairy above, downy beneath; stem leafless or rarely with 1 or 2 leaves (5–12′ high); raceme simple; petals oblong, often subserrate.—Rich rocky woods, N. S. to Ont. April, May.

3. MITELLA, Tourn. MITRE-WORT. BISHOP'S-CAP.

Calyx short, coherent with the base of the ovary, 5-cleft. Petals 5, slender, pinnatifid. Stamens 5 or 10, included. Styles 2, very short. Capsule short, 2-beaked, 1-celled, with 2 parietal or rather basal several-seeded placentæ, 2-valved at the summit. Seeds smooth and shining.—Low and slender perennials, with round heart-shaped alternate leaves on the rootstock or runners, on slender petioles; those on the flowering stems opposite, if any. Flowers small, in a simple slender raceme or spike. Fruit soon widely dehiscent. (Diminutive of *mitra*, a cap, alluding to the form of the young pod.)

1. **M. diphylla**, L. *Hairy; leaves heart-shaped, acute*, somewhat 3–5-lobed, toothed, *those on the many-flowered stem* 2, *opposite, nearly sessile*, with interfoliar stipules; flowers white, in a raceme 6–8′ long; stamens 10.—Hillsides in rich woods; Q. and Ont., west to Minn. and Mo. May.

2. **M. nuda**, L. Small and slender; *leaves rounded or kidney-form*, deeply and doubly crenate; *stem usually leafless, few-flowered*, very slender (4–6′ high); flowers greenish; stamens 10.—Deep moist woods, in moss, N.S. to the Pacific and northward. May–July.

4. CHRYSOSPLENIUM, Tourn. Golden Saxifrage.

Calyx-tube coherent with the ovary; the blunt lobes 4–5, yellow within. Petals none. Stamens 8–10, very short, inserted on a conspicuous disk. Styles 2. Capsule inversely heart-shaped or 2-lobed, flattened, very short, 1-celled with 2 parietal placentæ, 2-valved at the top, many-seeded.—Low and small smooth herbs, with tender succulent leaves, and small solitary or leafy-cymed flowers. (Name compounded of χρυσός, *golden*, and σπλήν, *the spleen;* probably from some reputed medicinal qualities.)

1. **C. Americanum**, Schwein. Stems slender, *decumbent* and forking; *leaves principally opposite*, roundish or somewhat heart-shaped, obscurely crenate-lobed; *flowers distant*, inconspicuous, *nearly sessile* (greenish tinged with yellow or purple).—Cold wet places, N. Scotia to Ont.

5. PARNASSIA, Tourn. Grass of Parnassus.

Sepals 5, imbricated in the bud, slightly united at the base, and sometimes also with the base of the ovary, persistent. Petals 5, veiny, spreading, at length deciduous, imbricated in the bud; a cluster of somewhat united gland-tipped sterile filaments at the base of each. Proper stamens 5, alternate with the petals, persistent; anthers introrse or subextrorse. Ovary 1-celled, with 4 projecting parietal placentæ; stigmas 4, sessile, directly over the placentæ. Capsule 4-valved, the valves bearing the placentæ on their middle. Seeds very numerous, anatropous, with a thick wing-like seed-coat and little if any albumen. Embryo straight; cotyledons very short. —Perennial smooth herbs, with entire leaves, and solitary flowers on long scape-like stems, which usually bear a single sessile leaf. Petals white, with greenish or yellowish veins. (Named from Mount Parnassus; called Grass of Parnassus by Dioscorides.)

1. **P. parviflora**, DC. *Petals sessile*, little longer than the calyx (3″ long); *sterile filaments about* 7 *in each set, slender; leaves ovate or oblong*, tapering at base.—Sandy banks, Lab. and westward.

2. **P. palustris,** L. Scapes 3–10′ high; leaves heart-shaped; flower nearly 1′ broad; *petals sessile*, rather longer than the calyx, few-veined; *sterile filaments* 9–15 *in each set, slender*.—Same range as the last. (Eu.)

3. **P. Caroliniana,** Michx. Scapes 9′–2° high; flower 1–1½′ broad; *petals sessile*, more than twice as long as the calyx, many-veined; *sterile filaments* 3 *in each set, stout, distinct almost to the base;* leaves thickish, ovate or rounded, often heart-shaped, usually but one low down on the scape and clasping.—Wet banks, N. Brunswick, Ont.

6. RIBES, L. Currant. Gooseberry.

Calyx 5-lobed, often colored; the tube coherent with the ovary. Petals 5, inserted in the throat of the calyx, small. Stamens 5, alternate with the petals. Ovary 1-celled, with 2 parietal placentæ and 2 distinct or united styles. Berry crowned with the shrivelled remains of the calyx; the surface of the numerous seeds swelling into a gelatinous outer coat investing a crustaceous one. Embryo minute at the base of hard albumen.—Low, sometimes prickly shrubs, with alternate and palmately-lobed leaves, which are plaited in the bud (except in one species), often fascicled on the branches; the small flowers from the same clusters, or from separate lateral buds. (From *riebs*, a German popular name for the currant. Grossularia was the proper name to have been adopted for the genus.)

§ 1. GROSSULARIA. Gooseberry. *Stems mostly bearing thorns at the base of the leafstalks or clusters of leaves, and often with scattered bristly prickles; berries prickly or smooth. (Our species are indiscriminately called* Wild Gooseberry; *the flowers greenish.)*

* *Peduncles 1–3-flowered; calyx as high as broad; leaves roundish-heart-shaped, 3–5-lobed.*

† *Calyx-lobes decidedly shorter than the tube; berries apt to be prickly.*

1. **R. Cynosbati,** L. Stamens and undivided style not longer than the broadly bell-shaped calyx; berries large, armed with long prickles or rarely smooth.—Rocky woods, N. Brunswick to Man.

† † *Calyx-lobes decidedly longer than the short and rather narrow tube; berries smooth, purple, sweet and pleasant.*

2. **R. oxyacanthoides,** L. *Peduncles very short, flowers greenish or dull purplish; stamens usually scarcely equalling the rather broadly oblong calyx-lobes.* (R. hirtellum, *Michx.*)—Newf. to the Pacific. The common smooth-fruited gooseberry of the north, the whitish spines often numerous.

§ 2. RIBESIA. CURRANT. *Thornless and prickless; racemes few–many-flowered; stamens short.*

3. **R. prostratum,** L'Her. FETID CURRANT. Stems reclined; leaves deeply heart-shaped, 5–7-lobed, smooth, the lobes ovate, acute, doubly-serrate; *racemes erect,* slender, calyx flattish; *pedicels and the (pale red) fruit glandular-bristly.*—Cold damp woods and rocks, Lab. to the Rocky Mts.

4. **R. floridum,** L'Her. WILD BLACK CURRANT. *Leaves sprinkled with resinous dots,* slightly heart-shaped, sharply 3–5-lobed, doubly serrate; *racemes drooping, downy; bracts longer than the pedicels;* flowers large, whitish; calyx tubular-bell-shaped, smooth; *fruit round-ovoid, black, smooth.*—Woods throughout Canada.

5. **R. rubrum,** L. var. **subglandulosum,** Maxim. RED CURRANT. Stems straggling or reclined; leaves somewhat heart-shaped, obtusely 3–5-lobed, serrate, downy beneath when young; *racemes from lateral buds distinct from the leaf-buds, drooping,* calyx flat (green or purplish); *fruit globose, smooth, red.*—Cold bogs and damp woods. N. S. to the Pacific.

ORDER 28. CRASSULACEÆ (ORPINE FAMILY).

Succulent herbs, with perfectly symmetrical flowers; viz., the petals and pistils equalling the sepals in number (3–20), *and the stamens the same or double their number,*—technically different from Saxifrageæ only in this complete symmetry, and in the carpels (in most of the genera) being quite distinct from each other. Also, instead of a perigynous disk, there are usually little scales on the receptacle, one behind each carpel. Fruit dry and dehiscent; the pods (follicles) opening down the ventral suture, many–rarely few-seeded.—Stipules none. Flowers usually cymose, small. Leaves mostly sessile.

* Leaves, etc., thick and succulent. Carpels distinct.

1. **Sedum.** Sepals, petals, and pistils 4 or 5. Stamens 8–10. seeds many.

1. SEDUM, Tourn. Stone-crop. Orpine.

Sepals and petals 4 or 5. Stamens 8 or 10. Follicles many-seeded; a little scale at the base of each.—Chiefly perennial, smooth, and thick-leaved herbs, with the flowers cymose or one-sided. Petals almost always narrow and acute or pointed. (Name from *sedeo*, to sit, alluding to the manner in which these plants fix themselves upon rocks and walls.)

* *Flowers perfect and sessile, as it were spiked along one side of spreading flowering branches or of the divisions of a scorpioid cyme, the first or central flower mostly* 5*-merous and* 10*-androus, the others often* 4*-merous and* 8*-androus.*

† *Flowers yellow.*

1. **S. acre,** L. Mossy Stone-crop. Spreading on the ground, moss-like; leaves very small, alternate, almost imbricated on the branches, ovate, very thick; petals yellow.—Escaped from cultivation to rocky roadsides, etc. July. (Nat. from Eu.)

* * *Flowers in a terminal naked and regular cyme or cluster, more or less peduncled; leaves flat, obovate or oblong, mostly alternate.*

† *Flowers perfect,* 5*-merous,* 10*-androus.*

2. **S. Telephium,** L. Garden Orpine or Live-for-ever. Stems erect (2° high), stout; leaves oval, obtuse, toothed; cymes compound; *petals purple,* oblong-lanceolate; *follicles abruptly pointed with a short style.*—Rocks and banks, escaped from cultivation in some places. July. (Adv. from Eu.)

† † *Flowers diœcious, mostly* 4*-merous, and* 8*-androus.*

3. **S. Rhodiola,** DC. Roseroot. Stems erect (5–10′ high); leaves oblong or oval, smaller than in the preceding; flowers in a close cyme, greenish-yellow, or the fertile turning purplish.—Throughout Arctic America, extending southward to the coast of Maine, and cliffs of Delaware River; also in the western mountains. May, June. (Eu.)

Order 29. DROSERACEÆ (Sundew Family).

Bog-herbs, mostly glandular-haired, with regular hypogynous flowers, pentamerous and withering-persistent calyx, corolla, and stamens, the

anthers fixed by the middle and turned outward, and a 1-celled capsule with twice as many styles or stigmas as there are parietal placentæ.—Calyx imbricated. Petals convolute. Seeds numerous, anatropous, with a short and minute embryo at the base of the albumen.—Leaves circinate in the bud, *i.e.*, rolled up from the apex to the base, as in Ferns. A small family of insectivorous plants.

1. DROSERA, L. Sundew.

Stamens 5. Styles 3, or sometimes 5, deeply 2-parted so that they are taken for 6 or 10, slender, stigmatose above on the inner face. Capsule 3- (rarely 5) valved; the valves bearing the numerous seeds on their middle for the whole length.—Low perennials or biennials; the leaves clothed with reddish gland-bearing bristles, in our species all in a tuft at the base; the naked scape bearing the flowers in a 1-sided raceme-like inflorescence, which nods at the undeveloped apex, so that the fresh-blown flower (which opens only in sunshine) is always highest. The plants yield a purple stain to paper. (The glands of the leaves exude drops of a clear glutinous fluid, glittering like dew-drops, whence the name, from δροσερός, *dewy.*)

1. **D. rotundifolia,** L. Round-leaved Sundew. *Leaves orbicular,* abruptly narrowed into the *spreading hairy petioles;* seeds spindle-shaped, the coat loose and chaff-like; flowers white, the parts sometimes in sixes.—Peat-bogs, Lab. to the Pacific and southward; common. July, August. (Eu.)

2. **D. intermedia,** Hayne, var. **Americana,** DC. *Leaves spatulate-oblong,* tapering into the long rather *erect naked petioles;* seeds oblong, with a rough close coat; flowers white. (D. longifolia, *Gray,* Manual.)—Bogs, N.B. to Man. June–Aug. (Eu.)

Order 30. HAMAMELIDEÆ (Witch-Hazel Family).

Shrubs or trees, with alternate simple leaves and deciduous stipules; flowers in heads or spikes, often polygamous or monœcious; the calyx cohering with the base of the ovary, which consists of 2 pistils united below, and forms a 2-beaked, 2-celled woody capsule, opening at the summit, with a single bony seed in each cell, or several, only one or two of them ripening.—Petals inserted on the calyx, narrow, valvate or involute in the bud, or often none at all. Stamens twice as

many as the petals, and half of them sterile and changed into scales, or numerous. Seeds anatropous. Embryo large and straight, in scanty albumen ; cotyledons broad and flat.

* Flowers with a manifest calyx, or calyx and corolla, and a single ovule suspended from the summit of each cell.

1. **Hamamelis.** Petals 4, strap-shaped. Stamens and scales each 4, short.

1. HAMAMELIS, L. Witch-Hazel.

Flowers in little axillary clusters or heads, usually surrounded by a scale-like 3-leaved involucre. Calyx 4-parted, and with 2 or 3 bractlets at its base. Petals 4, strap-shaped, long and narrow, spirally involute in the bud. Stamens 8, very short ; the 4 alternate with the petals anther-bearing, the others imperfect and scale-like. Styles 2, short. Capsule opening loculicidally from the top; the outer coat separating from the inner, which encloses the single large and bony seed in each cell, but soon bursts elastically into two pieces.—Tall shrubs, with straight-veined leaves, and yellow, perfect or polygamous flowers. (From ἅμα, *at the same time with*, and μηλίς, *an apple-tree;* a name anciently applied to the Medlar, or some similar tree.)

1. **H. Virginiana**, L. Leaves obovate or oval, wavy-toothed, somewhat downy when young ; blossoming late in autumn, when the leaves are falling, and maturing its seeds the next summer.—Damp woods, N.S. to Ont.

Order 31. ONAGRACEÆ (Evening-Primrose Family).

Herbs, with 4-merous (sometimes 2–3 or 5–6-merous) perfect and symmetrical flowers; the tube of the calyx cohering with the 2–4-celled ovary, its lobes valvate in the bud, or obsolete; the petals convolute in the bud, sometimes wanting; and the stamens as many or twice as many as the petals or calyx-lobes, inserted on the summit of the calyx-tube. Style single, slender ; stigma 2-4-lobed or capitate. Pollen grains often connected by cobwebby threads. Seeds anatropous, small, without albumen.—Mostly herbs, with opposite or alternate leaves. Stipules none or glandular.

* Parts of the flower in fours or more.

† Fruit a many-seeded pod, usually loculicidal.

‡ Calyx-tube prolonged beyond the ovary (scarcely so in n. 1) and deciduous from it. Flowers 4-merous.

1. **Epilobium.** Seeds silky-tufted. Flowers small, not yellow. Lower leaves often opposite.

2. **Œnothera.** Seeds naked. Flowers mostly yellow. Leaves alternate.

* * Parts of the flower in twos. Leaves opposite.

3. **Circæa.** Petals 2, obcordate or 2-lobed. Stamens 2. Fruit 1–2 seeded, bristly.

1. EPILOBIUM, L. Willow-herb.

Calyx-tube not or scarcely prolonged beyond the ovary; the limb 4-cleft or -parted, deciduous. Petals 4. Stamens 8; anthers short. Capsule linear, many-seeded. Seeds with a tuft of long hairs at the end.—Mostly perennials, with nearly sessile leaves, and violet, purple, or white flowers; in summer. A large genus, many of its species of difficult limitation. (Name composed of ἐπί, *upon*, and λόβιον, *a little pod.*)

§ 1. *Flowers large, purple, in a long raceme; calyx-limb deeply parted; petals entire; stamens and style successively deflexed; stigma of 4 long lobes.*

1. **E. angustifolium,** L. Great Willow-herb. Fire-weed. Stem simple, tall (4–7°); leaves scattered, ample, lanceolate, nearly entire.—Low grounds, especially in newly cleared lands; Lab., west, and far north. (Eu., Asia.)

§ 2. *Flowers mostly small and corymbed or panicled; calyx-limb 4-cleft; petals mostly deeply notched; stamens and style erect.*

* *Stigma clavate; stem somewhat quadrangular with 2–4 ridges or hairy lines decurrent from some of the leaves.*

† *Tall and mostly branching, many-flowered; leaves rather large, toothed, not revolute, the lower opposite; seeds papillose.*

2. **E. coloratum,** Muhl. Somewhat hoary-pubescent above or glandular, 1–3° high; leaves lanceolate, sharply serrulate or denticulate, acute, narrowed to conspicuous petioles; flowers pale, more or less nodding; peduncles shorter than the leaves; seeds dark, unappendaged; coma cinnamon-color.—Wet places, common.

† † *Mostly low, slender and simple (except forms of* n. 3*); leaves chiefly opposite, less toothed; flowers few, nodding; seeds appendaged at the apex.*

‡ *Seeds papillosed-roughened.*

3. **E. palustre,** L. Slender, 1° high or less, often branched, finely pubescent; leaves erect or ascending, about equalling or longer than the internodes, sessile, linear to linear-lanceolate or elliptic-oblong, obtuse, with revolute margins; capsules pubescent to nearly glabrous, mostly shorter than the slender peduncles; seeds fusiform, with long beak. (E. palustre, var. lineare, *Man.*, in part.)—Lab. to N. W. T. (Eu.)

2. ŒNOTHERA, L. Evening Primrose.

Calyx-tube prolonged beyond the ovary, deciduous; the lobes 4, reflexed. Petals 4. Stamens 8; anthers mostly linear and versatile. Capsule 4-valved, many-seeded. Seeds naked.—Leaves alternate. Flowers yellow, white or rose-color. (An old name, of unknown meaning, for a species of Epilobium.)

§ 1. *Stigma-lobes linear, elongated; calyx-tube linear, slightly dilated at the throat; anthers linear.*

* *Caulescent annuals or biennials; flowers erect in the bud, nocturnal, yellow, the calyx-tips free; capsules sessile, coriaceous; seeds in two rows in each cell.*

† *Flowers in a leafy spike; capsules stout, oblong, slightly narrowed above.*

1. **Œ. biennis,** L. Common Evening Primrose. Rather stout, erect (1–5° high), usually simple, more or less pubescent and hairy; leaves lanceolate to oblong- or rarely ovate-lanceolate (2–6′ long), acute or acuminate, repandly denticulate, the lowest petioled; calyx-tube 1–2½′ long, the tips of the sepals contiguous; petals ½–¾′ long; capsule more or less pubescent or hirsute.—Throughout Canada.

Var. **grandiflora,** Lindl., has petals as long as the calyx-tube (1–2½′ long.)—Same range as the type, but not so common east.

* * *Caulescent; flowers diurnal, yellow and erect in the bud; capsules obovate or clavate, quadrangular, the valves ribbed and the angles more or less strongly winged.*

2. **Œ. pumila,** L. Biennial, puberulent, 1–2° high; *leaves* mostly glabrous, *entire,* obtuse, the radical spatulate, the *cauline narrowly oblanceolate; flowers loosely spiked;* corolla 4–12″ long; *capsule glabrous,* oblong-clavate, 3–6″ long, sessile or on a short

pedicel, *slightly winged.* (Incl. Œ. chrysantha, *Michx.*)—Dry fields, N. Scotia to Man. June.

3. **Œ. fruticosa,** L. Sundrops. Biennial or perennial, erect, often tall and stout (1–3° high), villous-pubescent or puberulent, or nearly glabrous; leaves oblong to linear-lanceolate, *mostly denticulate; raceme corymbed or loose;* petals 9–12‴ long; *capsule subsessile or with a pedicel shorter than itself,* prominently ribbed and *strongly winged.*—Common, variable. N. S. and Q.

3. CIRCÆA, Tourn. Enchanter's Nightshade.

Calyx-tube slightly prolonged, the end filled by a cup-shaped disk, deciduous; lobes 2, reflexed. Petals 2, inversely heart-shaped. Stamens 2. Fruit indehiscent, small and burr-like, bristly with hooked hairs, 1–2-celled; cells 1-seeded.—Low and inconspicuous perennials, in cool or damp woods, with opposite thin leaves on slender petioles, and small whitish flowers in racemes, produced in summer. (Named from *Circe,* the enchantress.)

1. **C. Lutetiana,** L. Taller (1–2° high); *leaves ovate,* slightly toothed; *bracts none;* hairs of the *roundish 2-celled fruit bristly.*—Very common. N. S. to Ont. (Eu.)

2. **C. alpina,** L. *Low* (3–8′ high), *smooth and weak; leaves heart-shaped, thin, shining, coarsely toothed; bracts minute;* hairs of the obovate-oblong *1-celled fruit* soft and slender.—Deep woods, N. S. to the Pacific. (Eu.)

Order 32. CUCURBITACEÆ (Gourd Family).

Mostly succulent herbs with tendrils, diœcious or monœcious (often gamopetalous) flowers, the calyx-tube cohering with the 1–3*-celled ovary, and the* 5 *or usually* $2\frac{1}{2}$ *stamens* (*i.e.*, 1 with a 1-celled and 2 with 2-celled anthers) *commonly united by their often tortuous anthers, and sometimes also by the filaments. Fruit* (pepo) *fleshy, or sometimes membranaceous.*—Limb of the calyx and corolla usually more or less combined. Stigmas 2 or 3. Seeds large, usually flat, anatropous, with no albumen. Cotyledons leaf-like. Leaves alternate, palmately lobed or veined.—Mostly a tropical or subtropical order; represented in cultivation by the Gourd (Lagenaria vulgaris), Pumpkin and Squash (species of Cucurbita),

MUSKMELON (CUCUMIS MELO), CUCUMBER (C. SATIVUS), and WATERMELON (CITRULLUS VULGARIS).

* Fruit prickly. Seeds few, erect or pendulous. Flowers white. Annual.

† Ovary 1-celled. Seed solitary, pendulous.

1. **Sicyos.** Corolla of the sterile flowers flat and spreading, 5-lobed. Fruit indehiscent.

† † Ovary 2-3-celled. Seeds few, erect or ascending.

2. **Echinocystis.** Corolla of the sterile flowers flat and spreading, 6-parted. Anthers 3. Fruit bladdery, 2-celled, 4-seeded, bursting at the top.

1. SICYOS, L. ONE-SEEDED BUR-CUCUMBER.

Flowers monœcious. Petals 5, united below into a bell-shaped or flattish corolla. Anthers cohering in a mass. Ovary 1-celled, with a single suspended ovule; style slender; stigmas 3. Fruit ovate, dry and indehiscent, filled by the single seed, covered with barbed prickly bristles which are readily detached. — Climbing annuals, with 3-forked tendrils, and small whitish flowers; the sterile and fertile mostly from the same axils, the former corymbed, the latter in a capitate cluster, long-peduncled. (Greek name for the Cucumber.)

1. **S. angulatus,** L. Leaves roundish heart-shaped, 5-angled or lobed, the lobes pointed; plant clammy-hairy.—River banks, and a weed in damp yards, N.H. and Quebec to Ont., west to Minn., E. Kan., and Tex. July–Sept.

2. ECHINOCYSTIS, Torr. and Gray. WILD BALSAM-APPLE.

Flowers monœcious. Petals 6, lanceolate, united at the base into an open spreading corolla. Anthers more or less united. Ovary 2-celled, with 2 erect ovules in each cell; stigma broad. Fruit fleshy, at length dry, clothed with weak prickles, bursting at the summit, 2-celled, 4-seeded, the inner part fibrous-netted. Seeds large, flat, with a thickish hard and roughened coat.—Tall climbing annual, nearly smooth, with 3-forked tendrils, thin leaves, and very numerous small greenish-white flowers; the sterile in compound racemes often 1° long, the fertile in small clusters or solitary, from the same axils. (Name composed of ἐχῖνος, *a hedgehog*, and κύστις, *a bladder*, from the prickly fruit.)

1. **E. lobata,** Torr. and Gray. Leaves deeply and sharply 5-lobed; fruit oval (2′ long); seeds dark-colored.—Rich soil along rivers, N.S. westward. Also cult. for arbors. July–Oct.

ORDER 33. UMBELLIFERÆ (PARSLEY FAMILY).

Herbs, with small flowers in umbels (or rarely in heads), the calyx entirely adhering to the 2-celled and 2-ovuled ovary, the 5 petals and 5 stamens inserted on the disk that crowns the ovary and surrounds the base of the 2 styles. Fruit consisting of 2 seed-like dry carpels. Limb of the calyx obsolete, or a mere 5-toothed border. Petals either imbricated in the bud or valvate with the point inflexed. The two carpels (called *mericarps*) cohering by their inner face (the *commissure*), when ripe separating from each other and usually suspended from the summit of a slender prolongation of the axis (*carpophore*); each carpel marked lengthwise with 5 *primary ribs*, and often with 4 intermediate (*secondary*) ones; in the *interstices* or *intervals* between them are commonly lodged the oil tubes (*vittæ*), which are longitudinal canals in the substance of the fruit, containing aromatic oil. (These are best seen in slices made across the fruit.) Seed suspended from the summit of the cell, anatropous, with a minute embryo in hard albumen.—Stems usually hollow. Leaves alternate, mostly compound, the petioles expanded or sheathing at base; rarely with true stipules. Umbels usually compound, in which case the secondary ones are termed *umbellets*; the whorl of bracts which often subtends the general umbel is the *involucre*, and those of the umbellets the *involucels*. The base of the styles is frequently thickened and cushion-like, and called the *stylopodium*. In many the flowers are *dichogamous*, *i.e.*, the styles are protruded from the bud some time before the anthers develop, —an arrangement for cross-fertilization.—A large family, some of the plants innocent and aromatic, others with very poisonous (acrid-narcotic) properties. The flowers are much alike in all, and the fruits, inflorescence, etc., likewise exhibit comparatively small diversity. The family is consequently difficult for the young student.

I. Fruit with the secondary ribs the most prominent, winged and armed with barbed or hooked prickles, the primary ribs filiform and bristly.

1. **Daucus.** Calyx-teeth obsolete. Fruit flattened dorsally. Seed-face flat.

II. Fruit with primary ribs only (hence but 3 dorsal ones on each carpel).

IMAGE EVALUATION TEST TARGET (MT-3)

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6"

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* Fruit strongly flattened dorsally, with the lateral ribs prominently winged.

† Caulescent branching plants, with white flowers.

‡ Lateral wings closely contiguous; oil-tubes solitary; stylopodium thick-conical.

2. **Heracleum.** Dorsal ribs filiform, the broad wings with a marginal nerve. Oil-tubes obclavate. Petals conspicuous. Tall stout perennials, with large leaves.

† † Caulescent branching plants, with depressed stylopodium and yellow flowers.

3. **Pastinaca.** Fruit with filiform dorsal ribs, thin wings, and solitary oil-tubes.

* * Fruit not flattened either way or but slightly, neither prickly nor scaly.

† Ribs all conspicuously winged; stylopodium depressed or wanting.

4. **Thaspium.** Tall perennials, with ternately divided or simple leaves, and yellow flowers (rarely purple). Oil-tubes solitary.

* * * Fruit flattened laterally.

† Carpels terete or slightly flattened laterally; flowers white.

‡ Seed-face flat; fruit short.

‖ Leaves once pinnate; stylopodium depressed; oil-tubes numerous. Aquatic perennials.

5. **Sium.** Fruit ovate to oblong; ribs prominent, corky, nearly equal.

‖ ‖ Leaves decompound. Oil-tubes solitary. Perennials.

6. **Cicuta.** Ribs flattish, corky, the lateral largest. Marsh perennials, with serrate leaflets, the veins often running to the notches.

‡ ‡ Seed-face concave; fruit ovate, glabrous, with depressed stylopodium, and no oil-tubes.

7. **Conium.** An introduced biennial, with spotted stems, and large decompound leaves.

‡ ‡ ‡ Seed-face concave. Fruit linear-oblong, with conical stylopodium.

8. **Osmorrhiza.** Fruit bristly, with oil-tubes obsolete.

† † Carpels (as well as fruit) strongly flattened laterally.

‡ Seed straight, not sulcate; umbels simple.

9. **Hydrocotyle.** Fruit more or less orbicular, with no oil-tubes. Low perennials, in or near water, with creeping stems, and peltate or reniform leaves.

* * * * Fruit obovoid or globose, densely prickly or scaly.

10. **Sanicula.** Flowers in irregularly compound few-rayed umbels, yellow. Leaves palmate.

1. DAUCUS, Tourn. CARROT.

Calyx-teeth obsolete. Fruit oblong, flattened dorsally; stylopodium depressed; carpel with 5 slender bristly primary ribs and 4 winged secondary ones, each of the latter bearing a single row of barbed prickles; oil-tubes solitary under the secondary ribs, two on the commissural side; seed-face somewhat concave or almost flat.—Bristly annuals or biennials, with pinnately decompound leaves,

foliaceous and cleft involucral bracts, and white flowers in compound umbels which become strongly concave. (The ancient Greek name.)

1. **D. Carota,** L. Biennial; stem bristly; ultimate leaf-segments lanceolate and cuspidate; rays numerous.—Naturalized everywhere, from Eu.

2. HERACLEUM, L. Cow-Parsnip.

Calyx-teeth minute. Fruit broadly oval or obovate, like Pastinaca, but with a thick conical stylopodium, and the conspicuous obclavate oil-tubes extending scarcely below the middle.—Tall stout perennial, with large ternately compound leaves, broad umbels, deciduous involucre, and many-leaved involucels, white flowers, and obcordate petals, the outer ones commonly larger and 2-cleft. (Dedicated to *Hercules.*)

1. **H. lanatum,** Michx. Woolly; stem grooved, 4–8° high; leaflets broad, irregularly cut-toothed.—Wet ground, Newf. to the Pacific, and southward to N.C., Ky., and Kan. June.

3. PASTINACA, L. Parsnip.

Calyx-teeth obsolete. Fruit oval, very much flattened dorsally; dorsal ribs filiform, the lateral extended into broad wings, which are strongly nerved toward the outer margin; oil-tubes small, solitary in the intervals, 2–4 on the commissure; stylopodium depressed.—Tall stout glabrous biennial, with pinnately compound leaves, mostly no involucre or involucels, and yellow flowers. (The Latin name, from *pastus*, food.)

1. **P. sativa,** L. Stem grooved; leaflets ovate to oblong, cut-toothed.—Introduced everywhere. (Adv. from Eu.)

4. THASPIUM, Nutt. Meadow-Parsnip.

Calyx-teeth conspicuous. Fruit ovoid to oblong, slightly flattened dorsally; carpel with 3 or 4 or all the ribs strongly winged; oil-tubes solitary in the intervals, 2 on the commissure. Stylopodium wanting; styles long.—Perennials (2–5° high), with ternately divided leaves (or the lower simple) and broad serrate or toothed leaflets, mostly yellow flowers, and all the fruit pedicelled. (Name a play upon *Thapsia*, so called from the island of Thapsus.)

1. **T. aureum**, Nutt. *Glabrous; root-leaves mostly cordate serrate; stem-leaves simply ternate* (rarely biternate); leaflets ovate to lanceolate, round or tapering at base, serrate; *flowers deep yellow;* fruit globose-ovoid, about 2″ long, *all the ribs equally winged.*—Thickets and woodlands, N.B. to Ont. Fl. in summer and maturing fruit in late summer or autumn. Very variable.

5. SIUM, Tourn. Water Parsnip.

Calyx-teeth minute. Fruit ovate to oblong, glabrous, with prominent corky nearly equal ribs; oil-tubes 1–3 in the intervals; stylopodium depressed; seed-face plane.—Smooth perennials, growing in water or wet places, with pinnate leaves and serrate or pinnatifid leaflets, involucre and involucels of numerous narrow bracts, and white flowers. (From σίον, the Greek name of some marsh plant.)

1. **S. cicutæfolium**, Gmelin. *Stout*, 2–6° high; *leaflets* 3–8 *pairs*, linear to lanceolate, sharply serrate and mostly acuminate, 2–5′ *long* (lower leaves sometimes submersed and finely dissected, as in the next); *fruit* $1\frac{1}{2}$″ *long*, with prominent ribs. (S. lineare, *Michx.*)—Throughout N. America.

6. CICUTA, L. Water-Hemlock.

Calyx-teeth prominent. Fruit oblong to nearly orbicular, glabrous, with strong flattish corky ribs (the lateral largest); oil-tubes conspicuous, solitary; stylopodium depressed; seed nearly terete.—Smooth marsh perennials, very poisonous, with pinnately compound leaves and serrate leaflets, involucre usually none, involucels of several slender bractlets, and white flowers. (The ancient Latin name of the Hemlock.)

1. **C. maculata**, L. Spotted Cowbane. Musquash Root. Beaver-Poison. Stem *stout*, 2–6° high, streaked with purple; leaves 2–3 pinnate, the lower on long petioles; *leaflets lanceolate* to oblong-lanceolate (1–5′ long), acuminate, coarsely serrate, the veins passing to the notches; pedicels in the umbellets numerous, very unequal; fruit broadly ovate to oval, 1–$1\frac{1}{2}$″ long.—Throughout Canada. August.

2. **C. bulbifera**, L. *Rather slender*, 1–3° high; leaves 2–3-pinnate (sometimes appearing ternate); *leaflets linear*, sparsely toothed

(1–2′ long); *upper axils bearing clustered bulblets;* fruit (rare) scarcely 1″ long.—Common in swamps, N. Scotia, westward.

7. CONIUM, L. POISON HEMLOCK.

Calyx-teeth obsolete. Fruit ovate, somewhat flattened at the sides, glabrous, with prominent wavy ribs; oil-tubes none, but a layer of secreting cells next the seed, whose face is deeply and narrowly concave.—Poisonous biennial, with spotted stems, large decompound leaves with lanceolate pinnatifid leaflets, involucre and involucels of narrow bracts, and white flowers. (Κώνειον, the Greek name of the Hemlock, by which criminals and philosophers were put to death at Athens.)

1. **C. maculatum,** L. A large branching European herb, in waste places, Q. to Ont.

8. OSMORRHIZA, Raf. SWEET CICELY.

Calyx-teeth obsolete. Fruit linear to linear-oblong, with prominent caudate attenuation at base, very bristly, with equal ribs; oil-tubes obsolete; seed-face concave.—Glabrous to hirsute perennials (1–3° high) from thick aromatic roots, with ternately compound leaves, ovate variously toothed leaflets, few-leaved involucres and involucels, and white flowers in few-rayed and few-fruited umbels. (Name from *ὀσμή, a scent*, and *ῥίζα, a root.*)

1. **O. brevistylis,** DC. Rather stout, *villous-pubescent;* leaves 2–3-ternate; leaflets 2–3′ long, acuminate; fruit (not including the caudate attenuation) 6″ long; *stylopodium and style ½″ long.*—From N. Scotia westward to the R. Mts. May, June.

2. **O. longistylis,** DC. *Glabrous or slightly pubescent;* like the last, but with the *style* 1″ *long or more,* and the seed-face more deeply and broadly concave.—N. Scotia, westward.

9. HYDROCOTYLE, Tourn. WATER PENNYWORT.

Calyx-teeth obsolete. Fruit strongly flattened laterally, orbicular or shield-shaped; the carpels 5-ribbed, two of the ribs enlarged and often forming a thickened margin; oil-tubes none, but usually a conspicuous oil-bearing layer beneath the epidermis.—Low, mostly smooth, marsh or aquatic perennials, with slender creeping stems, and round shield-shaped or kidney-form leaves, with scale-like

stipules. Flowers small, white, in simple umbels or clusters, which are either single or proliferous (one above another), appearing all summer. (Name from ὕδωρ, *water*, and κοτύλη, *a flat cup*, the peltate leaves of several species being somewhat cup-shaped.)

* *Pericarp uniformly corky-thickened and ribs all filiform; leaves not peltate; peduncles much shorter than the petioles.*

† *Fruit small, without secondary ribs or reticulations; involucre small or none.*

1. **H. Americana**, L. Stems filiform, *branching and creeping; leaves thin*, round-reniform, *crenate-lobed* and the lobes crenate, shining; few-flowered umbels *axillary and almost sessile;* fruit less than 1″ broad; intermediate ribs prominent; no oil-bearing layer; seed-section broadly oval.—Common, N. S. to Ont.

10. SANICULA, Tourn. SANICLE. BLACK SNAKEROOT.

Calyx-teeth manifest, persistent. Fruit globular; the carpels not separating spontaneously, ribless, thickly clothed with hooked prickles, each with 5 oil-tubes.—Perennial rather tall glabrous herbs, with few palmately-lobed or parted leaves, those from the root long-petioled. Umbels irregular or compound, the flowers (greenish or yellowish) capitate in the umbellets, perfect, and with staminate ones intermixed. Involucre and involucels few-leaved. (Name said to be from *sano*, to heal; or perhaps from *San Nicolas.*)

1. **S. Marylandica**, L. Stem 1–3° high; leaves 3–7-parted, the divisions most sharply cut and serrate; sterile flowers numerous and long-pedicelled; fruit 1½–2″ long, the styles longer than the prickles.

Var. **Canadensis**, Torr., has comparatively few and short-pedicelled sterile flowers, and styles shorter than the prickles. (S. Canadensis, *L.*)—With the last, but westward only, Ont.

ORDER 34. **ARALIACEÆ** (GINSENG FAMILY).

Herbs, shrubs, or trees, with much the same characters as Umbelliferæ, *but with usually more than 2 styles, and the fruit a few–several-celled drupe.*—Albumen mostly fleshy. Petals not inflexed.

1. ARALIA, Tourn. GINSENG. WILD SARSAPARILLA.

Flowers more or less polygamous. Calyx-tube coherent with the ovary, the teeth very short or almost obsolete. Petals 5 epigynous,

oblong or obovate, lightly imbricated in the bud, deciduous. Stamens 5, epigynous, alternate with the petals. Styles 2–5, mostly distinct and slender, or in the sterile flowers short and united. Ovary 2–5-celled, with a single anatropous ovule suspended from the top of each cell, ripening into a berry-like drupe, with as many seeds as cells. Embryo minute.—Leaves compound or decompound. Flowers white or greenish, in umbels. Roots (perennial), bark, fruit, etc., warm and aromatic. (Derivation obscure.)

§ 1. ARALIA. *Flowers monœciously polygamous or perfect, the umbels usually in corymbs or panicles; styles and cells of the (black or dark purple) fruit* 5; *stems herbaceous or woody; ultimate divisions of the leaves pinnate.*

* *Umbels numerous in a large compound panicle; leaves very large, decompound.*

1. **A. racemosa,** L. SPIKENARD. *Herbaceous; stem widely branched; leaflets heart-ovate,* pointed, doubly serrate, slightly downy; umbels racemose; *styles united.*—Rich woodlands, N. S. to Ont., south to the mountains of Ga. July. Well known for its spicy-aromatic large roots.

** *Umbels* 2–7, *corymbed; stem short, somewhat woody.*

2. **A. hispida,** Vent. BRISTLY SARSAPARILLA. WILD ELDER. *Stem* (1–2° high) *bristly, leafy,* terminating in a peduncle bearing several umbels; leaves twice pinnate; leaflets oblong-ovate, acute, cut-serrate.—Rocky and sandy places, Newf. to Ont. and the Dakotas, south to the mountains of N. C. June.

3. **A. nudicaulis,** L. WILD SARSAPARILLA. *Stem scarcely rising out of the ground, smooth, bearing a single long-stalked leaf* (1° high) *and a shorter naked scape,* with 2–7 umbels; leaflets oblong-ovate or oval, pointed, serrate, 5 on each of the 3 divisions.—Moist woodlands; Atl. to R. Mts. May, June. The long horizontal aromatic roots a substitute for officinal Sarsaparilla.

§ 2. GINSENG. *Flowers diœciously polygamous; styles and cells of the red or reddish fruit* 2 *or* 3; *stem herbaceous, low, simple, bearing a whorl of* 3 *palmately* 3–7-*foliolate leaves, and a simple umbel on a slender peduncle.*

4. **A. quinquefolia**, Decsne. and Planch. GINSENG. *Root large and spindle-shaped, often forked* (4–9′ long, aromatic); stem 1° high; *leaflets long-stalked*, mostly 5, large and thin, obovate-oblong, pointed; styles mostly 2; *fruit bright red.*—Rich and cool woods, Q. and Ont., south to the mountains of Ga. July.

ORDER 35. CORNACEÆ (DOGWOOD FAMILY).

Shrubs or trees (rarely herbaceous), with opposite or alternate simple leaves, the calyx-tube coherent with the 1–2-celled ovary, its limb minute, the petals (valvate in the bud) and as many stamens borne on the margin of an epigynous disk in the perfect flowers; style one; a single anatropous ovule hanging from the top of the cell; the fruit a 1–2-seeded drupe; embryo nearly as long as the albumen, with large foliaceous cotyledons.—Including two genera, of which Nyssa is partly apetalous. Bark bitter and tonic.

1. **Cornus.** Flowers perfect, 4-merous. Leaves mostly opposite.

1. CORNUS, Tourn. CORNEL. DOGWOOD.

Flowers perfect (or in some foreign species diœcious). Calyx minutely 4-toothed. Petals 4, oblong, spreading. Stamens 4; filaments slender. Style slender; stigma terminal, flat or capitate. Drupe small, with a 2-celled and 2-seeded stone.—Leaves opposite (except in one species), entire. Flowers small, in open naked cymes, or in close heads surrounded by a corolla-like involucre. (Name from *cornu*, a horn; alluding to the hardness of the wood.)

§ 1. *Flowers greenish, in a head or close cluster, surrounded by a large and showy, 4-leaved, corolla-like, white or rarely pinkish involucre; fruit bright red.*

1. **C. Canadensis**, L. DWARF CORNEL. BUNCH-BERRY. *Stems low and simple* (5–7′ high) from a slender creeping and subterranean rather woody trunk; leaves scarcely petioled, the lower scale-like, the upper crowded into an apparent whorl in sixes or fours, ovate or oval, pointed; *leaves of the involucre ovate;* fruit globular.—Damp cold woods, Atlantic to the Pacific, and the far north. June.

§ 2. *Flowers white, in open flat spreading cymes; involucre none; fruit spherical; leaves all opposite (except in* n. 5).

* *Pubescence woolly and more or less spreading.*

2. **C. circinata,** L'Her. Round-leaved Cornel or Dogwood. Shrub 6–10° high; *branches greenish,* warty-dotted; *leaves round-oval, abruptly pointed, woolly beneath* (2–5′ broad); cymes flat; *fruit light blue.*—Copses, in rich or sandy soil, or on rocks, N. S. to Ont. June.

3. **C. sericea,** L. Silky Cornel. Kinnikinnik. Shrub 3–10° high; *branches purplish; the branchlets, stalks, and lower surface of the narrowly ovate or elliptical pointed leaves silky-downy* (often rusty), pale and dull; cymes flat, close; calyx-teeth lanceolate; *fruit pale blue.*—Wet places, N. B. to Ont. June.

* * *Pubescence closely appressed, straight and silky, or none.*

4. **C. stolonifera,** Michx. Red-osier Dogwood. *Branches, especially the osier-like shoots* of the season, *bright red-purple, smooth; leaves ovate,* rounded at base, abruptly short-pointed, roughish with a minute close pubescence on both sides, *whitish underneath;* cymes small and flat, rather few-flowered, smooth; *fruit white or lead-color.*—Wet places; common, Atlantic to the Pacific, northward. Multiplies freely by prostrate or subterranean suckers, and forms broad clumps, 3–6° high. June.

5. **C. alternifolia,** L. f. Shrub or tree 8–25° high; *branches greenish streaked with white, the alternate leaves clustered at the ends,* ovate or oval, long-pointed, acute at base, whitish and minutely pubescent beneath; cymes very broad and open; *fruit deep blue* on reddish stalks.—Hillsides in copses, N. S., Q., and Ont. May, June.

Division II. GAMOPETALÆ.

Floral envelopes consisting of both calyx and corolla, the latter composed of more or less united petals, that is, gamopetalous.

Order 36. CAPRIFOLIACEÆ (Honeysuckle Family).

Shrubs, or rarely herbs, with opposite leaves, no (genuine) stipules, the calyx-tube coherent with the 2–5-celled ovary, the stamens as many as (one fewer in Linnæa, doubled in Adoxa) *the lobes of the tubular or rotate corolla, and inserted on its tube.*—Fruit a berry, drupe, or pod, 1–several-seeded. Seeds anatropous, with small embryo in fleshy albumen.

Tribe I. SAMBUCEÆ. Corolla wheel-shaped or urn-shaped, regular, deeply 5 lobed. Stigmas 3–5, sessile or nearly so. Inflorescence terminal and cymose.

* Shrubs, with stamens as many as corolla-lobes and flowers in broad compound cymes.

1. **Sambucus.** Fruit berry-like, containing three small seed-like nutlets. Leaves pinnate.

2. **Viburnum.** Fruit a 1-celled 1-seeded drupe, with a compressed stone. Leaves simple.

Tribe II. LONICEREÆ. Corolla tubular, often irregular, sometimes 2-lipped. Style slender; stigma capitate.

* Herbs, with axillary flowers.

3. **Linnæa.** Stamens 4, one fewer than the lobes of the corolla. Fruit dry, 3-celled, but only 1-seeded. Creeping, with long-pedunculate twin flowers.

* * Erect or climbing shrubs, with scaly winter-buds.

4. **Diervilla.** Stamens 5. Corolla funnel-form, nearly regular. Pod 2-celled, 2-valved, many-seeded, slender.

1. SAMBUCUS, Tourn. Elder.

Calyx-lobes minute or obsolete. Corolla open urn-shaped, with a broadly spreading 5-cleft limb. Stamens 5. Stigmas 3. Fruit a berry-like juicy drupe, containing 3 small seed-like nutlets.—Shrubby plants, with a rank smell when bruised, pinnate leaves, serrate-pointed leaflets, and numerous small and white flowers in compound cymes. (The Latin name, perhaps from σαμβύκη, an ancient musical instrument.)

1. **S. Canadensis**, L. Common Elder. Stems scarcely woody (5–10° high); *leaflets* 5–11, *oblong*, mostly smooth, the lower often 3-parted; *cymes flat; fruit black-purple.*—Rich soil, in open places, N.S., westward. June, July.—Pith white.

2. **S. racemosa**, L. Red-berried Elder. Stems woody (2–12° high), the bark warty; *leaflets* 5–7, *ovate-lanceolate, downy underneath; cymes panicled, convex or pyramidal; fruit bright red* (rarely white). (S. pubens, *Michx.*)—Rocky woods, N.S., westward across the continent. May; the fruit ripening in June.—Pith brown. Both species occur with the leaflets divided into 3–5 linear-lanceolate 2–3-cleft or laciniate segments.

2. VIBURNUM, L. Arrow-wood. Laurestinus.

Calyx 5-toothed. Corolla spreading, deeply 5-lobed. Stamens 5. Stigmas 1–3. Fruit a 1-celled, 1-seeded drupe, with soft pulp and a thin-crustaceous (flattened or tumid) stone.—Shrubs, with simple

leaves, and white flowers in flat compound cymes. Petioles sometimes bearing little appendages which are evidently stipules. Leaf-buds naked, or with a pair of scales. (The classical Latin name, of unknown meaning.)

§ 1. *Cyme radiant, the marginal flowers neutral, with greatly enlarged flat corollas as in* Hydrangea ; *drupes coral-red turning darker, not acid ; stone sulcate ; leaves pinnately veined ; winter-buds naked.*

1. **V. lantanoides,** Michx. HOBBLE-BUSH. AMERICAN WAYFARING-TREE. Leaves (4–8′ across) round-ovate, abruptly pointed, heart-shaped at the base, closely serrate, the veins and veinlets beneath with the stalks and branchlets very rusty-scurfy ; cymes sessile, very broad and flat.—Cold moist woods, N.B. to Ont. May. A straggling shrub ; the reclining branches often taking root.

§ 2. *Cyme peduncled, radiant in* n. 2 ; *drupe light red, acid, globose; stone very flat, orbicular, not sulcate; leaves palmately veined; winter-buds scaly.*

2. **V. Opulus,** L. CRANBERRY-TREE. Nearly smooth, upright (4–10° high) ; leaves 3–5-ribbed, strongly 3-lobed, broadly wedge-shaped or truncate at base, the spreading lobes pointed, mostly toothed on the sides, entire in the sinuses ; petioles bearing 2 glands at the apex.—Low ground, along streams, from Anticosti and N.B. far westward. June, July.—The acid fruit is a substitute for cranberries, whence the names *High Cranberry-bush*, etc. The well-known SNOW-BALL TREE, or GUELDER ROSE, is a cultivated state, with the whole cyme turned into showy sterile flowers. (Eu.)

3. **V. pauciflorum,** Pylaie. A low straggling shrub ; leaves glabrous or loosely pubescent beneath, 5-ribbed at base, unequally serrate nearly all round, with 3 short lobes at the summit ; cyme few-flowered ; stamens shorter than the corolla.—Cold woods, Newf. and Lab., westward to the Rocky Mts.

§ 3. *Cyme never radiant ; drupes blue, or dark-purple or black at maturity.*

* *Leaves 3-ribbed from the rounded or subcordate base, somewhat 3-lobed ; stipules bristle-shaped.*

4. **V. acerifolium,** L. DOCKMACKIE. ARROW-WOOD. Shrub 3–6° high; leaves soft-downy beneath, the pointed lobes diverging, unequally toothed; cymes small, slender-peduncled; stamens exserted; fruit crimson turning purple; stone lenticular, hardly sulcate.—Cool rocky woods, from N. Brunswick westward.

** *Leaves (with base inclined to heart-shaped) coarsely toothed, prominently pinnately veined; stipules narrowly subulate; no rusty scurf; fruit ovoid, blue or purple; the stone grooved; cymes peduncled.*

† *Stone flat; leaves all short-petioled or subsessile.*

5. **V. pubescens,** Pursh. DOWNY A. A low, straggling shrub; leaves ovate or oblong-ovate, acute or taper-pointed, the veins and teeth fewer and less conspicuous than in the next, the lower surface and very short petioles soft-downy, at least when young; fruit dark-purple; the stone lightly 2-sulcate on the faces.—Rocks, etc., Q. to Man. June.

†† *Stone very deeply sulcate ventrally; leaves rather slender-petioled.*

6. **V. dentatum,** L. ARROW-WOOD. Smooth, 5–15° high, with ash-colored bark; leaves broadly ovate, very numerously sharp-toothed and strongly veined; fruit 3″ long; cross-section of stone between kidney- and horseshoe-shaped.—Wet places, N. Brunswick to Ont. June.—The pale leaves often with hairy tufts in the axils of the straight veins.

*** *Leaves finely serrate or entire, bright green; veins not prominent; stipules none; whole plant glabrous or with some minute rusty scurf; fruit black or with a blue bloom, sweet; stone very flat and even, broadly oval or orbicular.*

† *Cymes peduncled, about 5-rayed; drupes globose-ovoid, 3″ long; shrubs 5–12° high, in swamps.*

7. **V. cassinoides,** L. WITHE-ROD. Shoots scurfy-punctate; leaves thickish and *opaque or dull,* ovate to oblong, mostly with obtuse acumination, *obscurely veiny* (1–3′ long), *with margins irregularly crenulate-denticulate* or sometimes entire; *peduncle shorter than the cyme.* (V. nudum, var. cassinoides, *Torr. and Gray.*)—Newf. westward. Flowers earlier than the next.

†† *Compound cyme sessile, 3–5 rayed; drupes oval, 5–7″ long.*

8. **V. Lentago**, L. Sweet Viburnum. Sheep-berry. *Leaves ovate, strongly pointed*, closely and very *sharply serrate;* petioles long and margined; cyme large; fruit oval, ½′ long or more, ripe in autumn, edible; tree 15–30° high.—Woods and banks of streams, from the Atlantic westward and northward. Fl. in spring.

3. LINNÆA, Gronov. Twin-flower.

Calyx-teeth 5, awl-shaped, deciduous. Corolla narrow bell-shaped, almost equally 5-lobed. Stamens 4, two of them shorter, inserted toward the base of the corolla. Ovary and the small dry pod 3-celled, but only 1-seeded, two of the cells having only abortive ovules.—A slender creeping and trailing little evergreen, somewhat hairy, with rounded-oval sparingly crenate leaves contracted at the base into short petioles, and thread-like upright peduncles forking into 2 pedicels at the top, each bearing a delicate and fragrant nodding flower. Corolla purple and whitish, hairy inside. (Dedicated to the immortal *Linnæus*, who first pointed out its characters, and with whom this pretty little plant was a special favorite.)

1. **L. borealis**, Linnæus.—Moist mossy woods and cold bogs, from Atlantic to Pacific. June. (Eu.)

4. DIERVILLA, Tourn. Bush-Honeysuckle.

Calyx-tube tapering at the summit; the lobes slender, awl-shaped, persistent. Corolla funnel-form, 5-lobed, almost regular. Stamens 5. Pod ovoid-oblong, pointed, 2-celled, 2-valved, septicidal, many-seeded.—Low upright shrubs, with ovate or oblong pointed serrate leaves, and cymosely 3–several-flowered peduncles, from the upper axils or terminal. (Named in compliment to *Dr. Dierville*, who brought it from Canada to Tournefort.)

1. **D. trifida**, Moench. Leaves oblong-ovate, taper-pointed, petioled; peduncles mostly 3-flowered; pod long-beaked.—Rocks, Anticosti westward. June–Aug.—Flowers honey-color, not showy, as are the Japanese species cultivated under the name of Weigela.

Order 37. RUBIACEÆ (Madder Family).

Shrubs or herbs, with opposite entire leaves connected by interposed stipules, or in whorls without apparent stipules, the calyx coherent with the 2–4-celled ovary, the stamens as many as the lobes of the

regular corolla (4–5), *and inserted on its tube.*—Flowers perfect, but often dimorphous (as in Mitchella and Houstonia). Fruit various. Seeds anatropous or amphitropous. Embryo commonly pretty large, in copious hard albumen.—A very large family, the greater part, and all its most important plants (such as the Coffee and Peruvian-Bark trees), tropical.

I. CINCHONEÆ. Ovules numerous in each cell; leaves opposite.

1. **Houstonia.** Corolla salver-form or funnel-form, 4-lobed. Seeds rather few, thimble-shaped or saucer-shaped. Low herbs.

II. COFFEINEÆ. Ovules solitary in the cells; leaves mostly opposite.

† Flowers in a close and globose long-peduncled head. Fruit dry. Shrubs.

2. **Cephalanthus.** Corolla tubular; lobes 4. Fruit inversely pyramidal, 2–4-seeded.

† † Flowers twin; their ovaries united into one. Fruit a 2-eyed berry.

3. **Mitchella.** Corolla funnel-form; its lobes 4. A creeping herb.

1. HOUSTONIA, L.

Calyx 4-lobed, persistent; the lobes in fruit distant. Corolla salver-form or funnel-form, usually much longer than the calyx-lobes, 4-lobed, the lobes valvate in the bud. Stamens 4; anthers linear or oblong. Style 1; stigmas 2. Ovary 2-celled. Pod top-shaped, globular, or didymous, thin, its summit or upper half free from and projecting beyond the tube of the calyx, loculicidal across the top. Seeds rather few (4–20 in each cell), peltate and saucer-shaped or globular-thimble-shaped, pitted.—Small herbs, with short entire stipules connecting the petioles or narrowed bases of the leaves, and cymose or solitary and peduncled flowers. These are dimorphous, in some individuals with exserted anthers and short included style; in others the anthers included and the style long, the stigmas therefore protruding. (Named for *Dr. Wm. Houston*, an English botanist, who collected in Central America.)

* *Small and delicate, vernal-flowering; peduncles* 1-*flowered; corolla salver-form; upper half of the broad and somewhat* 2-*lobed pod free; seeds globular, with a very deep round cavity occupying the inner face.*

† *Perennial by delicate filiform creeping rootstocks or creeping stems; peduncles filiform,* 1–2′ *long.*

1. **H. cærulea**, L. Bluets. Innocence. Glabrous; *stems erect*, slender, sparingly branched from the base (3–5′ high); *leaves oblong-spatulate* (3–4″ long); peduncle filiform, erect; corolla *light blue*, pale lilac or nearly white with a yellowish eye, with tube much longer than its lobes or than those of the calyx.—Moist and grassy places, N.S. westward; producing from early spring to midsummer its delicate little flowers.

2. CEPHALANTHUS, L. Button-bush.

Calyx-tube inversely pyramidal, the limb 4-toothed. Corolla tubular, 4-toothed; the teeth imbricated in the bud. Style thread-form, much protruded. Stigma capitate. Fruit dry and hard, small, inversely pyramidal, 2–4-celled, at length splitting from the base upward into 2–4 closed 1-seeded portions.—Shrubs with the white flowers densely aggregated in spherical peduncled heads. (Name composed of *κεφαλή, a head*, and *ἄνθος, a flower*.)

1. **C. occidentalis**, L. Smooth or pubescent; leaves petioled, ovate or lanceolate-oblong, pointed, opposite or whorled in threes, with short intervening stipules.—Swamps and along streams, Q. and Ont. July, Aug.

3. MITCHELLA, L. Partridge-berry.

Flowers in pairs, with their ovaries united. Calyx 4-toothed. Corolla funnel-form, 4-lobed; the lobes spreading, densely bearded inside, valvate in the bud. Stamens 4. Style 1; stigmas 4, linear. Fruit a berry-like double drupe, crowned with the calyx-teeth of the two flowers, with 4 small seed-like bony nutlets to each flower. —A smooth and trailing small evergreen herb, with round-ovate and shining petioled leaves, minute stipules, white fragrant flowers often tinged with purple, and scarlet edible (but nearly tasteless) berries, which remain over winter. Flowers occasionally 3–6-merous, always dimorphous; all those of some individuals having exserted stamens and included stigmas; of others, included stamens and exserted style. (This very pretty plant commemorates *Dr. John Mitchell*, an early correspondent of Linnæus, and an excellent botanist, who resided in Virginia.)

1. **M. repens**, L.—Dry woods, creeping about the foot of trees, especially Coniferæ, throughout our range and southward. June,

July.—Leaves often variegated with whitish lines. Rarely the two flowers are completely confluent into one, with a 10-lobed corolla.

ORDER 38. COMPOSITÆ (COMPOSITE FAMILY).

Flowers in a close head (the compound flower of the older botanists), *on a common receptacle, surrounded by an involucre, with 5 (rarely 4) stamens inserted on the corolla, their anthers united in a tube (syngenesious).*—Calyx-tube united with the 1-celled ovary, the limb (called a *pappus*) crowning its summit in the form of bristles, awns, scales, teeth, etc., or cup-shaped, or else entirely absent. Corolla either strap-shaped or tubular; in the latter chiefly 5-lobed, valvate in the bud, the veins bordering the margins of the lobes. Style 2-cleft at the apex (in sterile flowers usually entire). Fruit seed-like (*achene*), dry, containing a single erect anatropous seed, with no albumen.—An immense family, in temperate regions chiefly herbs, without stipules, with perfect, polygamous, monœcious or diœcious flowers. The flowers with a strap-shaped (*ligulate*) corolla are called *rays* or *ray-flowers*; the head which presents such flowers, either throughout or at the margin, is *radiate.* The tubular flowers compose the *disk*; and a head which has no ray-flowers is said to be *discoid.* The leaves of the involucre, of whatever form or texture, are termed *scales.* The bracts or scales, which often grow on the receptacle among the flowers, are called the *chaff*; when these are wanting, the receptacle is said to be *naked.*—The largest order of Phænogamous plants. The genera are divided by the corolla into three series, only two of which are represented in the Northern United States. The first is much the larger.

Systematic Synopsis.

SERIES I. TUBULIFLORÆ.

Corolla tubular in all the perfect flowers, regularly 5- (rarely 3–4) lobed, ligulate only in the marginal or ray-flowers, which when present are either pistillate only, or neutral (with neither stamens nor pistil).

Tribe I. EUPATORIACEÆ. Heads discoid, the flowers all alike, perfect and tubular, never yellow. Branches of the style thickened upward or club-shaped, obtuse, very minutely and uniformly pubescent; the stigmatic lines indistinct.

* Pappus of slender bristles.

† Achene 5-angled; bristles of the pappus roughish.

1. **Eupatorium.** Involucre of more than 4 scales and the flowers few or many. Stems not twining.

Tribe II. ASTEROIDEÆ. Heads discoid, the flowers all alike and tubular; or else radiate, the outer ones ligulate and pistillate. Anthers not caudate at base. Branches of the style in the perfect flowers flat, smooth up to where the conspicuous marginal stigmatic lines abruptly terminate, and prolonged above this into a flattened lance-shaped or triangular appendage which is evenly hairy or pubescent outside.—Leaves alternate. Receptacle naked (destitute of chaff) in all our species.

*1. Ray-flowers yellow (in one species of Solidago whitish), or sometimes none at all.

† Pappus (at least of the disk) of copious slender or capillary bristles.

‖ Pappus simple.

2. **Solidago.** Heads few-many-flowered; rays 1–16. Pappus of numerous slender and equal capillary bristles.

*2. Ray-flowers white, blue, or purple, never yellow.

† Pappus of numerous long and capillary bristles; receptacle flat.

3. **Aster.** Heads many-flowered, on leafy peduncles. Involucral scales unequal, loosely or closely imbricated. Achenes flattish; pappus simple (rarely double), copious.

4. **Erigeron.** Heads many-flowered, on naked peduncles. Involucre of narrow equal scales, little imbricated. Achenes flattened; pappus simple and rather scanty, or with some outer minute scales.

Tribe III. INULOIDEÆ. Heads discoid (radiate only in Inula), the pistillate flowers mostly filiform and truncate. Anthers sagittate, the basal lobes attenuate into tails. Style-branches with unappendaged obtuse or truncate naked tips. Pappus capillary or none.

*1. Receptacle naked. Involucral scales many, scarious. Floccose-woolly herbs.

5. **Antennaria.** Heads diœcious. Pappus of sterile flowers club-shaped, of the fertile united at base and deciduous together.

6. **Anaphalis.** Heads diœcious or nearly so. Pappus not thickened above nor at all united at base.

7. **Gnaphalium.** Heads all fertile throughout. Pappus all capillary.

Tribe IV. HELIANTHOIDEÆ. Heads radiate or discoid. Involucre not scarious (nut-like in fruit in n. 8). Receptacle chaffy. Pappus never capillary, sometimes none. Anthers not caudate. Style-branches truncate or hairy-appendaged.

*1. Fertile flowers 1–5, the corolla none or reduced to a tube; staminate corolla funnelform. Pappus none.

† Heads of two sorts on the same plant, the upper staminate with an open cup-shaped involucre, the lower pistillate, of 1–4 flowers in a closed bur-like involucre.

8. **Ambrosia.** Scales of staminate involucre united. Fruit 1-seeded.

*2. Heads radiate, or rarely discoid; disk-flowers all perfect and fertile. Anthers blackish. Pappus none, or a crown or cup, or of one or two chaffy awns, never capillary, nor of several uniform chaffy scales.—Leaves more commonly opposite.

† Involucre of one or more rows of separate scales.

‡ Chaff scale-like, embracing or subtending the achenes.

|| Receptacle high, conical or columnar in fruit. Pappus none or a short crown.

9. **Rudbeckia.** Rays neutral. Achenes 4-sided, flat at the top, marginless.

|| || Receptacle flat to convex. Achenes not winged nor very flat.

10. **Helianthus.** Achenes flattened, bearing 2 very deciduous chaffy pointed scales.

* 3. Rays few, neutral, or wanting. Achenes obcompressed, *i.e.*, flattened parallel with the scales of the involucre (rarely terete). Involucre double; the outer spreading and often foliaceous. Receptacle flat. Leaves opposite.

11. **Bidens.** Pappus of 2 or more rigid and persistent downwardly barbed awns or teeth.

Tribe V. ANTHEMIDEÆ. Distinguished from the last two tribes by the more or less dry and scarious imbricated scales of the involucre. Heads radiate (ray mostly white) or discoid, the perfect flowers sometimes sterile and the pistillate rarely tubular. Achenes small; pappus a short crown or none.—Mostly strong-scented; leaves alternate.

* Receptacle chaffy, at least in part. Heads radiate, many-flowered.

12. **Achillea.** Achenes obcompressed. Heads small, campanulate or obovate.

* * Receptacle naked.

† Heads rather large, pedunculate, radiate or rarely rayless.

13. **Chrysanthemum.** Receptacle flattish. Rays many, pistillate. Pappus none.

† † Heads mostly small, discoid, corymbed or paniculate.

14. **Tanacetum.** Heads corymbed. Achene with broad summit; pappus a short crown.

Tribe VI. CYNAROIDEÆ. Flowers all tubular and perfect. Involucre much imbricated. Anthers caudate, long-appendaged at tip. Style-branches short or united, obtuse, unappendaged, smooth, with often a pubescent ring below. Pappus mostly bristly.—Leaves alternate.

* Achenes attached by the base. Flowers all alike.

† Leaves prickly. Style-branches coherent, usually a pubescent ring below.

SERIES II. LIGULIFLORÆ.

Tribe VII. CICHORIACEÆ. Corolla ligulate in all the flowers of the head, and all the flowers perfect.—Herbs, with milky juice. Leaves alternate.

* Pappus chaffy, or of both chaff and bristles.

15. **Cichorium.** Involucre double. Pappus a small crown of many bristle-form scales.

* * Pappus plumose.

16. **Leontodon.** Involucre calyculate. Achenes fusiform. Leaves radical.

* * * Pappus composed entirely of capillary bristles, not plumose.

† Achenes not flattened, columnar or terete, often slender.

‡ Achenes not beaked.

|| Flowers yellow or orange.

17. **Hieracium.** Involucre imbricated. Pappus tawny. Pilose perennials.

‡ ‡ Achenes beaked. Flowers yellow.

18. **Taraxacum.** Scapose. Involucre calyculate. Achenes 4–5-ribbed.

1. EUPATORIUM, Tourn. THOROUGHWORT.

Heads discoid, 3-many-flowered; flowers perfect. Involucre cylindrical or bell-shaped, of more than 4 scales. Receptacle flat or conical, naked. Corolla 5-toothed. Achenes 5-angled; pappus a single row of slender capillary barely roughish bristles.—Erect perennial herbs, often sprinkled with bitter resinous dots, with generally corymbose heads of white, bluish, or purple blossoms, appearing near the close of summer. (Dedicated to *Eupator Mithridates*, who is said to have used a species of the genus in medicine.)

§ 1. EUPATORIUM proper. *Receptacle flat.*

* *Heads cylindrical, 5–15-flowered; the purplish scales numerous, closely imbricated in several rows, of unequal length, slightly striate; stout herbs, with ample mostly whorled leaves, and flesh-colored flowers.*

1. **E. purpureum**, L. JOE-PYE WEED. TRUMPET-WEED. Stems tall and stout, simple; leaves 3–6 in a whorl, oblong-ovate or lanceolate, pointed, very veiny, roughish, toothed; corymbs very dense and compound.—Varies greatly in size (2–12° high), etc., and with spotted or unspotted, often dotted stems, etc.,—including several nominal species.—Low grounds; common.

** *Heads 3–20-flowered; involucre of 8–15 more or less imbricated and unequal scales, the outer ones shorter; flowers white.*

† *Leaves sessile or nearly so, with a narrow base, mostly opposite; heads mostly 5-flowered.*

|| *Leaves opposite, clasping or united at the base, long widely spreading; heads mostly 10–15-flowered; corymbs very compound and large.*

2. **E. perfoliatum**, L. THOROUGHWORT. BONESET. Stem stout (2–4° high), *hairy; leaves lanceolate, united at the base around the stem* (connate-perfoliate), tapering to a slender point, serrate, very veiny, wrinkled, downy beneath (5–8′ long); scales of the involucre linear-lanceolate.—Low grounds; common and well-known.—Varies with the heads 30–40-flowered, or with some or all of the leaves separated and truncate at base.

2. SOLIDAGO, L. Golden-rod.

Heads few–many-flowered, radiate; the rays 1–16, pistillate. Scales of the oblong involucre appressed, destitute of herbaceous tips (except n. 1). Receptacle small, not chaffy. Achenes many-ribbed, nearly terete; pappus simple, of equal capillary bristles.—Perennial herbs, with mostly wand-like stems and nearly sessile stem-leaves, never heart-shaped. Heads small, racemed or clustered; flowers both of the disk and ray (except in n. 3) yellow. (Name from *solidus* and *ago*, to join, or make whole, in allusion to reputed vulnery qualities.) Flowering in autumn.

Conspectus of Groups.

Heads all more or less pedicelled.
- Involucral scales rigid, with spreading herbaceous tips 1
- Involucral scales without green tips.
  - Heads small, mostly clustered in the axils of feather-veined leaves 2, 3
  - Heads mostly small or middle-sized; inflorescence paniculate (sometimes thyrsoidal).
    - Leaves 3-ribbed; heads in 1-sided spreading panicled racemes.
      - Pubescent or scabrous 12
    - Leaves not 3-ribbed, or only obscurely triple-nerved.
      - Heads large; leaves thickish, very smooth, entire. Seashore 6

§1. VIRGAUREA. *Rays mostly fewer than the disk-flowers; heads all more or less pedicelled.*

* *Scales of the much imbricated and rigid involucre with abruptly spreading herbaceous tips; heads in clusters or glomerate racemes, disposed in a dense somewhat leafy and interrupted wand-like compound spike.*

1. **S. squarrosa**, Muhl. Stem stout (2–5° high), hairy above; leaves large, oblong, or the lower spatulate-oval and tapering into a margined petiole, serrate, veiny; heads numerous; scales obtuse or acute; disk-flowers 16–24, the rays 12–16.—Rocky and wooded hills, N.S. to Ont.

** *Involucral scales without green tips and wholly appressed.*

† *Heads small (3″ long), clustered along the stem in the axils of the feather-veined leaves, or the upper forming a thyrse.*

‡ *Achenes pubescent.*

2. **S. latifolia**, L. Smooth or nearly so; *stem angled, zigzag*, simple or paniculate-branched (1–3° high); *leaves broadly ovate or oval, very strongly and sharply serrate, conspicuously pointed at both ends* (thin, 3–6′ long); heads in very short axillary clusters, or the clusters somewhat prolonged at the end of the branches; rays 3–4.—Moist shaded banks; N.S. to Ont.

‡ ‡ *Achenes glabrous; inflorescence more thyrsoid.*

3. **S. bicolor**, L. *Hoary or grayish with soft hairs*; stem mostly simple; leaves oblong or elliptical-lanceolate, acute at both ends, or the lower oval and tapering into a petiole, slightly serrate; *clusters or short racemes from the axils of the upper leaves*, forming an interrupted spike or crowded panicle; scales very obtuse; *rays* (5–14) *small, cream-color or nearly white.*—Var. CONCOLOR, Torr. and Gray, has the *rays yellow.*—Dry copses, N.S. westward.

† † *Heads small or middle-sized, panicled or sometimes thyrsoidal, not in a terminal corymbiform cyme; not alpine.*

‡ ‡ *Leaves more or less plainly 3-ribbed; heads in one-sided spreading or recurved racemes, forming an ample panicle. Not maritime.*

|| *Pubescent (at least the stem) or hispidulous-scabrous.*

4. **S. Canadensis**, L. *Stem rough-hairy*, tall and stout (3–6° high); *leaves lanceolate*, pointed, sharply serrate (sometimes almost entire), *more or less pubescent beneath and rough above*; *heads small*; *rays very short.*—Borders of thickets and fields; very common.—Varies greatly in the roughness and hairiness of the stem and leaves, the latter oblong-lanceolate or elongated linear-lanceolate;—in var. **procera**, whitish-woolly underneath; and in var. **scabra** also very rough above, often entire, and rugose-veined.

5. **S. nemoralis**, Ait. *Clothed with a minute and close grayish-hoary* (soft or roughish) *pubescence*; stem simple or corymbed at the summit ($\frac{1}{2}$–$2\frac{1}{2}$° high); leaves *oblanceolate or spatulate oblong*, the lower somewhat crenate-toothed and tapering into a petiole; racemes numerous, dense, at length recurved, forming a large and crowded compound raceme or panicle which is usually turned to one side; scales of the involucre linear-oblong, appressed; rays 5–9.—Dry sterile fields; very common. Flowers very bright yellow, beginning early in August.

3. ASTER, L. Starwort. Aster.

Heads many-flowered, radiate; the ray-flowers in a single series, fertile. Scales of the involucre more or less imbricated, usually with herbaceous or leaf-like tips. Receptacle flat, alveolate. Achenes more or less flattened; pappus simple, of capillary bristles.—Perennial herbs, with corymbed, panicled, or racemose heads; flowering in autumn. Rays white, purple, or blue; the disk yellow, often changing to purple.—(Name ἀστήρ, *a star*, from the radiate heads of flowers.)

Conspectus of Groups.

Scales closely imbricated, scarcely at all herbaceous; leaves cordate, serrate .. 1, 2
Scales with herbaceous tips or the outer wholly foliaceous. Aster proper.
  Lower leaves more or less cordate, petiolate 4
  Involucre (and branchlets) viscid or glandular; leaves not cordate, mostly entire, the cauline all sessile or clasping 3
  Lower leaves all acute at base; not glandular nor viscid nor silky-canescent.
    Remaining species; branches erect or ascending.
      Stem-leaves auriculate-clasping or with winged-petiole-like base; involucre lax 5

§ 1. BIOTIA. *Involucre obovoid-bell-shaped; the scales regularly imbricated in several rows, appressed, nearly destitute of herbaceous tips; rays* 6–18 (*white or nearly so*); *achenes slender; pappus slightly rigid, simple; lower leaves large, heart-shaped, petioled, coarsely serrate; heads in open corymbs.*

1. **A. corymbosus,** Ait. *Stem slender,* somewhat zigzag; *leaves thin, smoothish, coarsely and unequally serrate with sharp spreading teeth, taper-pointed,* ovate or ovate-lanceolate, all but the uppermost heart-shaped at the base and on slender naked petioles; *rays* 6–9.—Woodlands; common, especially northward. July, Aug.—Plant 1–2° high, with smaller heads, looser corymbs, rounder and less rigid exterior involucral scales, and thinner leaves than the next; not rough, but sometimes pubescent.

2. **A. macrophyllus,** L. *Stem stout and rigid* (2–3° high); *leaves thickish, rough, closely serrate,* abruptly pointed; the lower heart-shaped (4–10′ long, 3–6′ wide), long-petioled; the upper ovate or oblong, sessile or on margined petioles; heads in ample rigid corymbs; *rays* 10–15 (white or bluish).—Moist woods; common.

Aug., Sept.—Involucre $\frac{1}{2}'$ broad; the outer scales rigid, oblong or ovate-oblong, the innermost much larger and thinner.

§ 2. ASTER proper. *Scales imbricated in various degrees, with herbaceous or leaf-like summits, or the outer entirely foliaceous; rays numerous; pappus simple, soft and nearly uniform (coarser and more rigid in the first group); achenes flattened.* (All flowering late in summer or in autumn.)

* 1. *Involucre and usually the branchlets viscidly or pruinose-glandular, well imbricated or loose; pubescence not silky; leaves entire (or the lower with few teeth), the cauline all sessile or clasping; rays showy, violet to purple.*

† *Heads larger; involucral scales spreading, in few or many ranks.*

3. **A. Novæ-Angliæ**, L. *Stem stout, hairy* (3–8° high), corymbed at the summit; *leaves very numerous, lanceolate, entire, acute, auriculate-clasping, clothed with minute pubescence*, 2–5′ long; *scales nearly equal, linear-awl-shaped, loose, glandular-viscid*, as well as the branchlets; rays violet-purple (in var. ROSEUS rose-purple), very numerous; achenes hairy.—Moist grounds; common.—Heads large. A peculiar and handsome species.

* 2. *Lower leaves heart-shaped and petioled; no glandular or viscid pubescence; heads with short and appressed green-tipped scales, mostly small and numerous, racemose or panicled.*

† *Rays 0–20, involucral scales appressed or erect.*

‡ *Leaves conspicuously serrate; heads small; rays pale blue or nearly white.*

4. **A. cordifolius**, L. Stem much branched above, *the spreading or diverging branches bearing very numerous panicled heads;* lower leaves all heart-shaped, on slender and mostly naked ciliate petioles; *scales of the inversely conical involucre all appressed and tipped with very short green points, obtuse or acutish.*—Woodlands; very common.—Heads profuse, but quite small. Varies with the stem and leaves either smooth, roughish, or sometimes hairy, also with the leaves all narrower.

* 3. *Without heart-shaped petioled leaves, the radical and lower all acute or attenuate at base; not glandular nor viscid, nor silky-canescent.*

† *Involucre various, the heads when numerous densely or loosely paniculate on erect or ascending branches.*

‡ *Cauline leaves conspicuously contracted into a winged-petiole-like base or auriculate-clasping; involucre lax.*

5. **A. puniceus,** L. Stem tall and stout 3–7° high, rough-hairy all over or in lines, usually purple below, panicled above; leaves oblong-lanceolate, not narrowed or but slightly so to the auricled base, coarsely serrate to sparingly denticulate in the middle, rough above, nearly smooth beneath, pointed, heads 4–6″ high, subsessile; scales narrowly linear, acute, loose, equal, in about 2 rows; rays long and showy (lilac-blue, paler in shade).—Low thickets and swamps; very common.

4. ERIGERON, L. Fleabane.

Heads many-flowered, radiate, mostly flat or hemispherical; the narrow rays very numerous, pistillate. Involucral scales narrow, equal and little imbricated, never coriaceous, foliaceous, nor green-tipped. Receptacle flat or convex, naked. Achenes flattened, usually pubescent and 2-nerved; pappus a single row of capillary bristles, with minuter ones intermixed, or with a distinct short outer pappus of little bristles or chaffy scales.—Herbs, with entire or toothed and generally sessile leaves, and solitary or corymbed naked-pedunculate heads. Disk yellow; ray white or purple. (Name from ἦρ, *spring,* and γέρων, *an old man,* suggested by the hoariness of some vernal species.)

§ 1. ERIGERON proper. *Rays elongated, crowded in one or more rows.*

* *Leafy-stemmed perennials; pappus simple.*

1. **E. bellidifolius,** Muhl. Robin's Plantain. Hairy, *producing offsets from the base; stem simple, rather naked above,* bearing few (1–9) large heads on slender peduncles; root-leaves obovate and spatulate, sparingly toothed, the cauline distant, lanceolate-oblong, partly clasping, entire; *rays (about 50) rather broad, light bluish-purple.*—Copses and moist banks; common. May.

2. **E. Philadelphicus,** L. Common Fleabane. Hairy; *stem leafy,* corymbed, bearing several small heads; leaves thin, with a broad midrib, oblong; the upper smoothish, clasping by a heart-

shaped base, mostly entire, the lowest spatulate, toothed; *rays innumerable and very narrow, rose-purple* or flesh-color.—Moist ground; common. June–August.

5. ANTENNARIA, Gaertn. EVERLASTING.

Heads many-flowered, diœcious; flowers all tubular; pistillate corollas very slender. Involucre dry and scarious, white or colored, imbricated. Receptacle convex or flat, not chaffy. Anthers caudate. Achenes terete or flattish; pappus a single row of bristles, in the fertile flowers capillary, united at base so as to fall in a ring, and in the sterile thickened and club-shaped or barbellate at the summit.—Perennial white-woolly herbs, with entire leaves and corymbed (rarely single) heads. Corolla yellowish. (Name from the resemblance of the sterile pappus to the *antennæ* of certain insects.)

1. **A. plantaginifolia**, Hook. PLANTAIN-LEAVED EVERLASTING. Spreading by offsets and runners, low (3–18′ high); leaves silky-woolly when young, at length green above and hoary beneath; those of the simple and scape-like flowering stems small, lanceolate, appressed; the radical obovate or oval-spatulate, petioled, ample, 3-nerved; heads in a small crowded corymb; scales of the (mostly white) involucre obtuse in the sterile, and acutish and narrower in the fertile plant.—Sterile knolls and banks; common. Ma ch–May.

6. ANAPHALIS, DC. EVERLASTING.

Characters as of Antennaria, but the pappus in the sterile flowers not thickened at the summit or scarcely so, and that of the fertile flowers not at all united at base; fertile heads usually with a few perfect but sterile flowers in the centre. (Said to be an ancient Greek name of some similar plant.)

1. **A. margaritacea**, Benth. and Hook. PEARLY EVERLASTING. Stem erect (1–2° high), corymbose at the summit, with many heads, leafy; leaves broadly to linear-lanceolate, taper-pointed, sessile, soon green above; involucral scales pearly-white, very numerous, obtuse or rounded, radiating in age. (Antennaria margaritacea, *R. Br.*)—Dry hills and woods; common. August. (N. E. Asia.)

7. GNAPHALIUM, L. CUDWEED.

Heads many-flowered; flowers all tubular, the outer pistillate and very slender, the central perfect. Scales of the involucre dry

and scarious, white or colored, imbricated in several rows. Receptacle flat, naked. Anthers caudate. Achenes terete or flattish; pappus a single row of capillary rough bristles.— Woolly herbs, with sessile or decurrent leaves, and clustered or corymbed heads; fl. in summer and autumn. Corolla whitish or yellowish. (Name from *γνάφαλον, a lock of wool*, in allusion to the floccose down.)

§ 1. GNAPHALIUM proper. *Bristles of the pappus distinct.*

1. **G. polycephalum,** Michx. Common Everlasting. Erect, woolly annual (1–3° high), fragrant; *leaves lanceolate, tapering at the base*, with undulate margins, *not decurrent*, smoothish above; *heads clustered at the summit of the panicled-corymbose branches*, ovate-conical before expansion, then obovate; scales (whitish) ovate and oblong, rather obtuse; perfect flowers few.—Old fields and woods; common.

2. **G. uliginosum,** L. Low Cudweed. *Diffusely branched*, appressed woolly annual (3–6′ high); leaves spatulate-oblanceolate or linear, not decurrent; *heads (small) in terminal sessile capitate clusters* subtended by leaves; scales brownish, less imbricated.—Low grounds; common, N.S. to Ont., and northward; perhaps introduced. (Eu.)

8. AMBROSIA, Tourn. Ragweed.

Sterile and fertile flowers occupying different heads on the same plant; the fertile 1–3 together and sessile in the axil of leaves or bracts, at the base of the racemes or spikes of sterile heads. Sterile involucres flattish or top-shaped, of 7–12 scales united into a cup, containing 5–20 funnel-form staminate flowers, with slender chaff intermixed, or none. Anthers almost separate. Fertile involucre (fruit) oblong or top-shaped, closed, pointed, resembling an achene (usually with 4–8 tubercles or horns near the top in one row), and enclosing a single flower which consists of a pistil only; the elongated style-branches protruding. Achenes ovoid; pappus none.—Coarse homely weeds, with opposite or alternate lobed or dissected leaves, and inconspicuous greenish flowers, in late summer and autumn; ours annuals. (The Greek and later Latin name of several plants, as well as of the food of the gods.)

§ 1. *Sterile heads in single or panicled racemes or spikes, the involucre regular.*

* *Leaves many of them alternate, all once or twice pinnatifid.*

1. **A. artemisiæfolia,** L. Roman Wormwood. Hog-weed. Bitter-weed. Much-branched (1–3° high), hairy or roughish-pubescent; *leaves thin, twice-pinnatifid,* smoothish above, paler or hoary beneath; *fruit* obovoid or globular, *armed with about 6 short acute teeth or spines.*—Waste places, everywhere.—Extremely variable, with finely cut leaves, on the flowering branches often undivided; rarely the spikes bear all fertile heads.

9. RUDBECKIA, L. Cone-flower.

Heads many-flowered, radiate; the rays neutral. Scales of the involucre leaf-like, in about 2 rows, spreading. Receptacle conical or columnar; the short chaff concave, not rigid. Achenes 4-angular (in our species), smooth, not margined, flat at the top, with no pappus, or a minute crown-like border.—Chiefly perennial herbs, with alternate leaves, and showy terminal heads; the rays generally long, yellow, often darker at base. (Named in honor of the *Professors Rudbeck,* father and son, predecessors of Linnæus at Upsal.)

* *Disk columnar in fruit dull greenish-yellow; leaves divided and cut.*

1. **R. laciniata,** L. Stem smooth, branching (2–7° high); leaves smooth or roughish, the lowest pinnate, with 5–7-cut or 3-lobed leaflets; upper leaves irregularly 3–5-parted, the lobes ovate-lanceolate, pointed, or the uppermost undivided; heads long peduncled; disk at first globular or hemispherical; chaff truncate, downy at the tip; rays oblanceolate (1–2′ long), drooping.—Low thickets; common. July–Sept.

** *Disk hemispherical to oblong-ovoid in fruit, dark purple or brown.*

† *Leaves undivided, rarely laciniately toothed.*

2. **R. hirta,** L. *Biennial,* very rough and bristly-hairy throughout; stems simple or branched near the base, stout (1–2° high), naked above, bearing single large heads; *leaves nearly entire; the upper oblong or lanceolate, sessile;* the lower spatulate, triple-nerved, petioled; rays (about 14) more or less exceeding the involucre; *chaff of the dull brown disk hairy at the tip,* acutish.—Dry soil; now common as a weed. June–Aug.

10. HELIANTHUS, L. Sunflower.

Heads many-flowered, radiate; rays several or many, neutral. Involucre imbricated, herbaceous or foliaceous. Receptacle flat or

convex; the persistent chaff embracing the 4-sided and laterally compressed smooth achenes, which are neither winged nor margined. Pappus very deciduous, of 2 thin chaffy scales on the principal angles, and sometimes 2 or more small intermediate scales.—Coarse and stout herbs, with solitary or corymbed heads, and yellow rays; flowering toward autumn. (Named from ἥλιος, *the sun*, and ἄνθος, *a flower*.)

§ 1. *Perennials; receptacle convex or at length low-conical; lower leaves usually opposite.*

* *Involucre loose, the scales acuminate or elongated or foliaceous; disk yellow (anthers dark).*

† *Leaves narrow, chiefly alternate, not 3-nerved, scabrous both sides; heads rather small; scales loose, attenuate.*

1. **H. giganteus**, L. *Stem hairy or rough* (3–10° high), branched above; *leaves lanceolate*, pointed, minutely serrate or nearly entire, green both sides, narrowed and ciliate at base, but *nearly sessile;* scales long, linear-lanceolate, pointed, hairy or strongly ciliate.—Low thickets and swamps; common.

† † *Leaves all or most of them opposite, 3-nerved.*

‡ *Heads larger; rays usually over* 10; *spreading by creeping rootstocks.*

|| *Leaves sessile or subsessile to short-petiolate, serrulate or entire.*

2. **H. divaricatus**, L. Stem simple or forked and corymbed at the top (1–4° high), *smooth below; leaves all opposite and divaricate, ovate-lanceolate, 3-nerved from the rounded or truncate sessile base,* tapering gradually to a sharp point (3–6′ long), serrate, *thickish, rough both sides;* scales narrowly lanceolate, attenuate, ciliate, equalling the disk; rays 8–12.—Thickets and barrens; common.—Disk 6″ wide; rays 1′ long.

|| || *Leaves longer-petiolate, thinnish or soft, coarsely serrate, commonly broad; scales loose, hirsute-ciliate.*

3. **H. decapetalus**, L. Stem branching (2–5° high), smooth below; leaves smooth or roughish, ovate, pointed, abruptly contracted into margined petioles; scales lanceolate-linear, elongated, loosely spreading, sometimes foliaceous, the outer longer than the disk; rays about 10.—Copses and low banks of streams; common.

11. BIDENS, L. Bur-Marigold.

Heads many-flowered; the rays when present 3–8, neutral. Involucre double, the outer commonly large and foliaceous. Receptacle flattish; the chaff deciduous with the fruit. Achenes flattened parallel with the scales of the involucre, or slender and 4-sided, crowned with 2 or more rigid and persistent awns which are downwardly barbed.—Annual or perennial herbs, with opposite various leaves, and mostly yellow flowers. (Latin, *bidens*, two-toothed.)

* *Achenes flat, not tapering at the summit; outer involucre foliaceous; annuals.*

† *Heads erect, nearly rayless; leaves mostly petiolate.*

1. **B. frondosa,** L. Common Beggar-ticks. Stick-tight. Smooth or rather hairy, tall (2–6° high), branching; *leaves 3–5-divided; leaflets mostly stalked,* lanceolate, pointed, coarsely toothed; outer involucre much longer than the head, ciliate below; *achenes wedge-obovate, 2-awned, ciliate* (the bristles ascending except near the summit).—Moist waste places; a coarse troublesome weed, the achenes, as in the other species, adhering to clothing, etc., by their retrorsely barbed awns. July–Oct.

2. **B. connata,** Muhl. Swamp Beggar-ticks. Smooth (1–2° high); *leaves lanceolate* or oblong-lanceolate, pointed, sharply serrate, tapering into margined slightly united petioles; *the lower often 3-divided, their lateral divisions united at the base and decurrent on the petiole;* outer scales longer than the head, few, mostly obtuse; *rays none; achenes narrowly wedge-form,* 3- (2–4) *awned, the margins minutely retrorsely ciliate.*—N.B. westward.

† † *Heads somewhat nodding, commonly radiate; leaves sessile, undivided.*

3. **B. cernua,** L. Smaller Bur-Marigold. Nearly smooth (5′–3° high); *leaves lanceolate, unequally serrate, scarcely connate; heads* nodding, *with or without* (light yellow) *rays;* outer involucre longer than the head; achenes wedge-obovate, 4-awned, the margins downwardly barbed.—Wet places, N.S. westward. July–Sept.—Rays, if any, smaller than in n. 4, and the outer involucre more leaf-like. (Eu.)

4. **B. chrysanthemoides,** Michx. LARGER BUR-MARIGOLD. Smooth, erect, or reclining at the base (6′–2° high); *leaves lanceolate*, tapering at both ends, more or less connate; *regularly serrate;* outer involucre mostly shorter than the *showy golden-yellow* (1′ *long*) *rays;* achenes wedge-shaped, with almost prickly downwardly barbed margins; awns 2, 3, or 4.—Swamps; common. Aug.–Oct.

12. ACHILLEA, L. YARROW.

Heads many-flowered, radiate; the rays few, fertile. Involucral scales imbricated, with scarious margins. Receptacle chaffy, flattish. Achenes oblong, flattened, margined; pappus none.—Perennial herbs, with small corymbose heads. (So named because its virtues are said to have been discovered by *Achilles.*)

1. **A. Millefolium,** L. COMMON YARROW or MILFOIL. Stems simple; *leaves twice-pinnately parted*; the divisions linear, 3–5-cleft, crowded; corymb compound, flat-topped; *involucre oblong*; *rays* 4–5, *short*, white (sometimes rose-color).—Fields and hills; common. Aug. (Eu.)

13. CHRYSANTHEMUM, Tourn. OX-EYE DAISY.

Heads many-flowered; rays numerous, fertile. Scales of the broad and flat involucre imbricated, with scarious margins. Receptacle flat or convex, naked. Disk-corollas with a flattened tube. Achenes of disk and ray similar, striate, without pappus.—Perennial herbs, with toothed, pinnatifid, or divided leaves, and single or corymbed heads. Rays white; disk yellow. (Old Greek name, *χρυσάνθεμον*, *i.e.* golden flower.)

1. **C. Leucanthemum,** L. OX-EYE or WHITE DAISY. WHITE-WEED. Stem erect, nearly simple, naked above and bearing a single large head; root-leaves spatulate, petioled, the others partly clasping, all cut or pinnatifid-toothed; scales of the involucre with rusty-brown margins. (Leucanthemum vulgare, *Lam.*)—Fields and meadows; common. June, July. A pernicious weed, with large and showy heads. It occurs with abortive, deformed, or tubular and laciniate rays. (Nat. from Eu.)

14. TANACETUM, L. TANSY.

Heads many-flowered, nearly discoid; flowers all fertile, the marginal chiefly pistillate and 3–5-toothed. Involucre imbricated,

dry. Receptacle convex naked. Achenes angled or ribbed, with a large flat top; pappus a short crown.—Bitter and acrid strong-scented herbs (ours perennial), with 1–3-pinnately dissected leaves, and corymbed heads. Flowers yellow; in summer. (Name of uncertain derivation.)

1. **T. vulgare,** L. COMMON TANSY. Stem (2–4° high) smooth; leaflets and the wings of the petiole cut-toothed; corymb dense; pistillate flowers terete, with oblique 3-toothed limb; pappus 5-lobed.—Var. CRISPUM has the leaves more cut and crisped.—Escaped from gardens to roadsides; common. (Nat. from Eu.)

15. CICHORIUM, Tourn. SUCCORY OR CHICORY.

Heads several flowered. Involucre double, herbaceous, the inner of 8–10 scales, the outer 5, short and spreading. Achenes striate; pappus of numerous small chaffy scales, forming a short crown.—Branching perennials, with deep roots; the sessile heads 2 or 3 together, axillary and terminal. Flowers bright blue, varying to purple or pink, showy. (Altered from the Arabian name of the plant.)

1. **C. Intybus,** L. Stem-leaves oblong or lanceolate, partly clasping, the lowest runcinate, those of the rigid flowering branches minute.—Roadsides, everywhere. July–Oct. (Nat. from Eu.)

16. LEONTODON, L. HAWKBIT.

Heads many-flowered. Involucre scarcely imbricated, but with several bractlets at the base. Achenes spindle-shaped, striate, all alike; pappus persistent, composed of plumose bristles which are enlarged and flattened toward the base.—Low and stemless perennials, with toothed or pinnatifid root-leaves, and scapes bearing one or more yellow heads. (Name from λέων, *a lion*, and ὀδούς, *a tooth*, in allusion to the toothed leaves.)

1. **L. autumnalis,** L. FALL DANDELION. Leaves laciniate-toothed or pinnatifid, somewhat pubescent; scape branched, 5–15′ high; peduncles thickened at the summit, scaly-bracteate.—Meadows and roadsides; N.S. to Ont. June–Nov. (Nat. from Eu.)

17. HIERACIUM, Tourn. HAWKWEED.

Heads 12–many-flowered. Involucre more or less imbricated. Achenes short, oblong or columnar, striate, not beaked; pappus a

single row of tawny and fragile capillary rough bristles.—Hispid or hirsute and often glandular perennials, with entire or toothed leaves, and single or panicled heads of mostly yellow flowers; summer and early autumn. (Name from *ἱέραξ, a hawk.*)

§ 1. *Involucre not much imbricate, scarcely calyculate; achenes oblong; pappus not copious.*

1. **H. Canadense,** Michx. Stems simple, leafy, corymbed at the summit (1–3° high); leaves sessile, lanceolate or ovate-oblong, acute, remotely and very coarsely toothed, somewhat hairy, the uppermost slightly clasping.—Dry woods, N.S. westward.

§ 2. *Heads small; involucre cylindrical, scarcely imbricated.*

* *Achenes columnar, not attenuate upward when mature; panicle not virgate.*

2. **H. scabrum,** Michx. Stem rather stout (1–3° high), leafy, *rough-hairy,* the stiff panicle at first racemose, at length rather corymbose; the thickish pedicels and the hoary 40–50-flowered involucre densely clothed with dark glandular bristles; leaves obovate or oval, nearly entire, hairy.—Dry open woods; common.

18. TARAXACUM, Haller. Dandelion.

Head many-flowered, large, solitary on a slender hollow scape. Involucre double, the outer of short scales; the inner of long linear scales, erect in a single row. Achenes oblong-ovate to fusiform, 4–5-ribbed, the ribs roughened, the apex prolonged into a very slender beak, bearing the copious soft and white capillary pappus. —Perennials or biennials; leaves radical, pinnatifid or runcinate; flowers yellow. (Name from *ταράσσω, to disquiet* or *disorder,* in allusion to medicinal properties.)

1. **T. officinale,** Weber. Common Dandelion. Smooth, or at first pubescent; outer involucre reflexed. (T. Dens-leonis, *Desf.*) —Pastures and fields everywhere. Indigenous forms occur northward and in the Rocky Mountains. April–September.—After blossoming, the inner involucre closes, and the slender beak elongates and raises up the pappus while the fruit is forming; the whole involucre is then reflexed, exposing to the wind the naked fruits, with the pappus displayed in an open globular head. (Eu.)

ORDER 40. LOBELIACEÆ (LOBELIA FAMILY).

Herbs with acrid milky juice, alternate leaves, and scattered flowers, an irregular monopetalous 5-lobed corolla; the 5 stamens free from the corolla, and united into a tube commonly by their filaments and always by their anthers.—Calyx-tube adherent to the many-seeded pod. Style 1; stigma often fringed. Seeds anatropous, with a small straight embryo, in copious albumen.—Nearly passing into the following order.

1. LOBELIA, L.

Calyx 5-cleft, with a short tube. Corolla with a straight tube, split down on the (apparently) upper side, somewhat 2-lipped; the upper lip of 2 rather erect lobes, the lower lip spreading and 3-cleft. Two of the anthers in our species bearded at the top. Pod 2-celled, many-seeded, opening at the top.—Flowers axillary or chiefly in bracted racemes; in summer and early autumn. (Dedicated to *Matthias De l'Obel*, an early Flemish herbalist.)

* *Flowers deep red, large; stem simple.*

1. **L. cardinalis**, L. CARDINAL-FLOWER. Tall (2–4° high), smoothish; leaves oblong-lanceolate, slightly toothed; raceme elongated, rather 1-sided; the pedicels much shorter than the leaf-like bracts.—Low grounds; common.

** *Flowers blue, or blue variegated with white.*

† *Flowers rather large (corolla-tube 5–6″ long), spicate-racemose; stems leafy, 1–3° high; perennial.*

‡ *Leaves ovate to lanceolate, numerous; lip of corolla glabrous.*

2. **L. syphilitica**, L. GREAT LOBELIA. *Somewhat hairy; leaves thin, acute at both ends* (2–6′ long), irregularly serrate; flowers (nearly 1′ long) pedicelled, longer than the leafy bracts; calyx hirsute, the *sinuses with conspicuous deflexed auricles*, the short *tube hemispherical.*—Low grounds, common.—Flowers light blue, rarely white.

† † *Flowers smaller (corolla-tube not more than 2–3″ long).*

‡ *Stem leafy, often paniculately branched; flowers loosely racemose; sinuses of calyx not appendaged; annual or biennial.*

|| *Leaves chiefly linear, entire or denticulate; pod not inflated.*

3. **L. Kalmii,** L. Stem mostly low (4–18′ high), minutely angled; *pedicels filiform, not exceeding* the linear or setaceous *bracts but as long as the flower, minutely 2-bracteolate or 2-glandular above the middle; calyx-tube top-shaped or obovoid,* fully half the length of the lobes, in fruit rather longer than they, covering the whole pod; corolla light blue, 4–5″ long.—Wet limestone rocks, Anticosti westward.

|||| *Leaves ovate or oblong, obtusely toothed; pod inflated, wholly inferior.*

4. **L. inflata,** L. INDIAN TOBACCO. Stems paniculately much branched from an annual root, pubescent with spreading hairs (1–2° high); leaves gradually diminishing into leaf-like bracts, which exceed the lower short-pedicelled flowers; calyx-tube ovoid.—Dry open fields.—Corolla only 1½–2″ long. Plant poisonous and a noted quack medicine.

ORDER 40. CAMPANULACEÆ (CAMPANULA FAMILY).

Herbs, with milky juice, alternate leaves, and scattered flowers; calyx adherent to the ovary; the regular 5-lobed corolla bell-shaped, valvate in the bud; the 5 stamens usually free from the corolla and distinct.—Style 1, usually beset with collecting hairs above; stigmas 2 or more. Capsule 2–several-celled, many-seeded. Seed small, anatropous, with a straight embryo in fleshy albumen. Flowers generally blue and showy.

1. CAMPANULA, Tourn. BELLFLOWER.

Calyx 5-cleft. Corolla generally bell-shaped, 5-lobed. Stamens 5, separate; the filaments broad and membranaceous at the base. Stigmas and cells of the capsule 3 in our species, the short pod opening on the sides by as many valves or holes.—Herbs, with terminal or axillary flowers; in summer. (A diminutive of the Italian *campana*, a bell, from the shape of the corolla.)

* *Style straight; openings of capsule below the middle.*

† *Slender perennials, mostly glabrous; flowers one or few, on slender peduncles.*

1. **C. rotundifolia,** L. HAREBELL. Slender, branching (5–12′ high), 1–10-flowered; *root-leaves round-heart-shaped* or ovate, mostly

toothed or crenate, long-petioled, early withering away; *stem-leaves* numerous, *linear or narrowly lanceolate, entire, smooth*; *calyx-lobes awl-shaped*, from $\frac{1}{3}$ to $\frac{2}{3}$ the length of the bright-blue corolla (which is 6–9″ long); *capsule nodding.*—Rocky shaded banks, Lab. to R. Mts.—A delicate and pretty species, but with a most inappropriate name, since the round root-leaves are rarely obvious. (Eu.)

** *Style declined and upwardly curved, much longer than the rotate corolla; openings of the capsule close to the summit; inflorescence spicate.*

2. C. Americana, L. TALL BELLFLOWER. Annual; stem mostly simple (3–6° high); leaves ovate and ovate-lanceolate, taper-pointed, serrate, mostly on margined petioles, thin, somewhat hairy ($2\frac{1}{2}$–6′ long); spike 1–2° long; corolla light blue, 1′ broad.—Moist rich soil, N.B. to Ont.

ORDER 41. ERICACEÆ (HEATH FAMILY).

Shrubs, sometimes herbs, with the flowers regular or nearly so; stamens as many or twice as many as the 4–5-lobed or 4–5-petalled corolla, free from but inserted with it; *anthers* 2-celled, *commonly appendaged, or opening by terminal chinks or pores, introrse* (except in Sub-order 3); *style* 1; *ovary* 3–10-*celled.* Pollen compound, of 4 united grains (except in Sub-order 4). Seeds small, anatropous. Embryo small, or sometimes minute, in fleshy albumen.—A large family, very various in many of the characters, comprising four well-marked sub-orders, as follows:—

SUB-ORDER I. **Vaccinieæ.** WHORTLEBERRY FAMILY. Calyx-tube adherent to the ovary, which forms an edible berry or berry-like fruit, crowned with the short calyx-teeth. Anther-cells opening at the apex.—Shrubs or somewhat woody plants, with scaly buds.

1. **Gaylussacia.** Ovary 10-celled, with a single ovule in each cell. Fruit a berried drupe with 10 small seed-like nutlets.
2. **Vaccinium.** Berry 4–5-celled (or imperfectly 8–10-celled by false partitions), many-seeded. Anther-cells tapering upward into a tube.
3. **Chiogenes.** Berry 4-celled, many-seeded, its summit free. Anther-cells not prolonged into a tube, but each 2-pointed. Slender trailing evergreen.

SUB-ORDER II. **Ericineæ.** HEATH FAMILY proper. Calyx free from the ovary. Corolla gamopetalous, rarely polypetalous, hypogynous.—Shrubs or small trees.

Tribe I. ANDROMEDEÆ. Fruit a loculicidal capsule (berry-like in n. 6). Corolla deciduous.

* Anther-cells opening through their whole length, not appendaged.

4. **Epigæa.** Corolla salver-shaped. Calyx of 5 separate dry and pointed sepals.

* * Anther-cells opening only at the top. Corolla not salver-shaped.

† Calyx becoming enlarged and berry-like in fruit.

5. **Gaultheria.** Calyx 5-cleft, in fruit enclosing the capsule. Anthers 4-awned at top.

Tribe III. RHODODENDREÆ. Fruit a septicidal capsule. Corolla deciduous.

* Anther-cells opening by a hole or chink at the top.

† Flowers not from scaly buds; the bracts leaf-like or coriaceous.

6. **Kalmia.** Corolla broadly bell-shaped or wheel-shaped, with 10 pouches receiving as many anthers. Leaves oblong or linear.

† † Flowers developed from large scaly buds, the scales or bracts caducous.

7. **Rhododendron.** Flowers usually 5-merous. Corolla bell-shaped or funnel-form, lobed or parted, often somewhat irregular. Leaves deciduous or evergreen.

8. **Ledum.** Corolla regular, all 5 petals nearly separate. Stamens 5–10. Leaves evergreen.

SUB-ORDER III. **Pyroleæ.** PYROLA FAMILY. Calyx free from the ovary. Corolla polypetalous. Anthers extrorse in the bud, opening by pores at the base (inverted in the flower). Seeds with a loose and translucent cellular coat much larger than the nucleus.

Tribe I. PYROLEÆ. Herbs or nearly so, with evergreen foliage. Pollen-grains compound. Capsule 5- (rarely 4) celled.

9. **Chimaphila.** Stems leafy. Flowers corymbed or umbelled. Petals widely spreading. Style very short and top-shaped. Valves of the capsule smooth on the edges.

10. **Moneses.** Scape 1-flowered. Petals widely spreading. Style straight, exserted; stigma 5-rayed. Valves of the capsule smooth on the edges.

11. **Pyrola.** Acaulescent. Flowers in a raceme. Petals not widely spreading. Filaments awl-shaped. Style long. Valves of the capsule cobwebby on the edges.

SUB-ORDER IV. **Monotropeæ.** INDIAN-PIPE FAMILY. Flowers nearly as in Sub-orders 2 or 3, but the plants herbaceous, root-parasitic, entirely destitute of green foliage, and with the aspect of Beech-drops. Seeds as in Sub-order 3.

* Corolla of 4 or 5 separate petals; calyx imperfect or bract-like.

12. **Monotropa.** Petals narrow. Anthers kidney-shaped, opening across the top.

1. GAYLUSSACIA, HBK. HUCKLEBERRY.

Corolla tubular, ovoid, or bell-shaped; the border 5-cleft. Stamens 10; anthers awnless; the cells tapering upward into more

or less of a tube, opening by a chink at the end. Fruit a berry-like drupe, containing 10 seed-like nutlets.—Branching shrubs, with the aspect of Vaccinium, commonly sprinkled with resinous dots; the flowers (white tinged with purple or red) in lateral and bracted racemes. (Named for the distinguished chemist, *Gay-Lussac.*)

* *Leaves deciduous, entire, sprinkled more or less with resinous or waxy atoms.*

1. **G. resinosa,** Torr. and Gray. BLACK HUCKLEBERRY. Much branched, rigid, *slightly pubescent* when young (1–3° high); *leaves* oval, oblong-ovate, or oblong, thickly clothed and at first *clammy, as well as the flowers, with shining resinous globules*; racemes short, clustered, one-sided; pedicels about the length of the flowers; *bracts and bractlets (reddish) small and deciduous*; corolla ovoid-conical, or at length cylindrical with an open mouth; fruit black, without bloom (pleasant, very rarely white).—Rocky woodlands and swamps, Newf. westward. May, June.—The common *Huckleberry* of the markets.

2. VACCINIUM, L. BLUEBERRY. BILBERRY. CRANBERRY.

Corolla various in shape; the limb 4–5-cleft, revolute. Stamens 8 or 10; anthers sometimes 2-awned on the back; the cells separate and prolonged upward into a tube, opening by a hole at the apex. Berry 4–5-celled, many-seeded, or sometimes 8–10-celled by a false partition stretching from the back of each cell to the placenta.—Shrubs with solitary, clustered, or racemed flowers; the corolla white or reddish. (Ancient Latin name, of obscure derivation.)

§ 1. CYANOCOCCUS. BLUEBERRIES. *Corolla cylindraceous to campanulate, 5-toothed; filaments hairy; anthers included, awnless; berry (sweet and edible) blue or black with bloom, completely or incompletely 10-celled; flowers in fascicles or short racemes, short-pedicelled, appearing from large scaly buds with or before the leaves.*

* *Corolla rather short and broad.* BLUEBERRIES OR BLUE HUCKLEBERRIES.

1. **V. Pennsylvanicum,** Lam. DWARF BLUEBERRY. Dwarf (6–15′ high), smooth, with green warty stems and branches; *leaves*

lanceolate or oblong, distinctly serrulate with bristle-pointed teeth, smooth and shining both sides (or sometimes downy on the midrib underneath); corolla short, cylindrical-bell-shaped; berries bluish-black and glaucous.—Dry hills, Newf. to Sask. The lowest and earliest ripened of the blueberries.

2. **V. Canadense,** Kalm. Low (1–2° high); *leaves oblong-lanceolate or elliptical, entire, downy both sides,* as well as the crowded branchlets; corolla shorter; otherwise as the last.—Swamps or moist woods, common.

3. **V. corymbosum,** L. COMMON OR SWAMP-BLUEBERRY. *Tall* (5–10° high); *leaves ovate, oval, oblong, or elliptical-lanceolate*; corolla varying from turgid-ovate and cylindrical-urn-shaped to oblong-cylindrical, 3–4″ long.—Swamps and low thickets, Newf. to Ont. This yields the common *blueberry* or *blue huckleberry* of the latter part of the season.

§ 2. OXYCOCCUS. *Corolla deeply 4-parted or -cleft, with linear reflexed lobes; anthers exserted, awnless, with very long terminal tubes; berry 4-celled; flowers axillary or terminal, nodding on long filiform pedicels.*

* *Stems very slender, creeping or trailing; leaves small, entire, whitened beneath, evergreen; pedicels erect, the pale rose-colored flower nodding; corolla 4-parted; berries red, acid.*—CRANBERRIES.

4. **V. Oxycoccus,** L. SMALL CRANBERRY. Stems very slender (4-9′ long); *leaves ovate, acute, with strongly revolute margins* (2–3″ long); pedicels 1-4, terminal; filaments fully ½ as long as the anthers.—Peat-bogs, Newf. to Pacific and northward. June.—Berry 3–4″ broad, often speckled with white when young; seldom gathered for market. (Eu., Asia.)

5. **V. macrocarpon,** Ait. LARGE OR AMERICAN CRANBERRY. Stems elongated (1–4° long), the flowering branches ascending; *leaves oblong, obtuse,* less revolute (4–6″ long); pedicels several, becoming lateral; filaments scarcely one-third the length of the anthers.—Peat-bogs, Newf. to Sask. and northward. June.—Berry ½–1′ long.

3. CHIOGENES, Salisb. CREEPING SNOWBERRY.

Calyx-tube adherent to the ovary; limb 4-parted, persistent. Corolla bell-shaped, deeply 4-cleft. Stamens 8, included, inserted

on an 8-toothed disk; filaments very short and broad; anther-cells ovate-oblong, separate, not awned on the back, but each minutely 2-pointed at the apex, and opening by a large chink down to the middle. Berry white, globular, rather dry, 4-celled, many-seeded. —A trailing and creeping evergreen, with very slender and scarcely woody stems, and small Thyme-like, ovate and pointed leaves on short petioles, with revolute margins, smooth above, the lower surface and the branches beset with rigid rusty bristles. Flowers very small, solitary in the axils, on short nodding peduncles, with 2 large bractlets under the calyx. (Name from χιών, *snow*, and γένος, *offspring*, in allusion to the snow-white berries.)

1. **C. serpyllifolia**, Salisb. Leaves 3–4″ long; berries 3″ broad, bright white. (C. hispidula, *Torr. and Gray.*)—Peat-bogs and mossy woods, Lab. to R. Mts. and northward. May.—Plant with the aromatic flavor of Gaultheria or Sweet Birch.

4. EPIGÆA, L. Ground Laurel. Trailing Arbutus.

Corolla salver-form; the tube hairy inside, as long as the ovate-lanceolate pointed and scale-like nearly distinct sepals. Stamens 10, with slender filaments; anthers oblong, awnless, opening lengthwise. Style slender, its apex (as in Pyrola) forming a sort of ring or collar around and partly adnate to the 5 little lobes of the stigma. Capsule depressed-globular, 5-lobed, 5-celled, many-seeded.—A prostrate or trailing scarcely shrubby plant, bristly with rusty hairs, with evergreen and reticulated rounded and heart-shaped alternate leaves, on slender petioles, and with rose-colored flowers in small axillary clusters, from scaly bracts. (Name composed of ἐπί, *upon*, and γῆ, *the earth*, from the trailing growth.)

1. **E. repens**, L. Sandy woods, or in rocky soil, especially in the shade of pines, Newf. to Ont.—Flowers appearing in early spring, exhaling a rich spicy fragrance, dimorphous as to style and stamens and subdiœcious. In New England called Mayflower.

5. GAULTHERIA, Kalm. Aromatic Wintergreen.

Corolla cylindrical-ovoid or a little urn-shaped, 5-toothed. Stamens 10, included; anther-cells each 2-awned at the summit, opening by a terminal pore. Capsule depressed, 5-lobed, 5-celled, 5-valved, many-seeded, enclosed when ripe by the calyx, which thickens and turns fleshy, so as to appear as a globular red berry.

Shrubs, or almost herbaceous plants, with alternate evergreen leaves and axillary (nearly white) flowers; pedicels with 2 bractlets. (Dedicated by Kalm to "*Dr. Gaulthier*," of Quebec.)

1. **G. procumbens,** L. CREEPING WINTERGREEN. Stems slender and extensively creeping on or below the surface; the flowering branches ascending, leafy at the summit (3–5′ high); leaves obovate or oval, obscurely serrate; flowers few, mostly single in the axils, nodding.—Cool damp woods, mostly in the shade of evergreens, Newf. to L. of Woods; also far northward. July.—The bright red berries (formed of the calyx) and the foliage have the well-known spicy-aromatic flavor of the Sweet Birch. Usually called *Wintergreen*, or sometimes in the interior *Tea-berry*. Eastward it is often called *Checkerberry* or *Partridge-berry* (names also applied to Mitchella, the latter especially so), also *Boxberry*.

6. KALMIA, L. AMERICAN LAUREL.

Calyx 5-parted. Corolla between wheel-shaped and bell-shaped, 5-lobed, furnished with 10 depressions in which the 10 anthers are severally lodged; filaments long and thread-form. Capsule globose, 5-celled, many-seeded.—Evergreen mostly smooth shrubs, with alternate or opposite entire coriaceous leaves, naked buds, and showy flowers. (Dedicated to *Peter Kalm*, a pupil of Linnæus, who travelled in this country about the middle of the last century, afterwards Professor at Abo.)

§ 1. *Flowers in simple or clustered naked umbel-like corymbs; pedicels from the axils of small and firm foliaceous persistent bracts; calyx smaller than the pod, persistent; leaves and branches glabrous, or nearly so.*

1. **K. angustifolia,** L. SHEEP LAUREL. LAMBKILL. WICKY. Shrub 1–3° high; *leaves commonly opposite or in threes, pale or whitish underneath, light green above, narrowly oblong*, obtuse, petioled; *corymbs lateral* (appearing later than the shoots of the season), slightly glandular, many-flowered; pod depressed, nearly smooth; *pedicels recurved in fruit.*—Hillsides, Marit. Prov.; common. May, June.

2. **K. glauca,** Ait. PALE LAUREL. *Branchlets 2-edged; leaves opposite, nearly sessile, oblong, white-glaucous beneath, with revolute*

margins; corymbs terminal, few-flowered, smooth; bracts large; flowers ½′ broad, lilac-purple; pod ovoid, smooth.—Cold peat-bogs and mountains, Newf., Pacific, and northward. May, June.—Straggling, about 1° high.

7. RHODODENDRON, L. Rose Bay, Azalea, etc.

Flowers almost always 5-merous. Calyx mostly small or minute. Corolla various (but not contracted at the orifice), lobed or cleft, or even parted, often somewhat irregular. Stamens sometimes as few as the corolla-lobes, more commonly twice as many, usually declined; anther-cells opening by a round terminal pore. Capsule 5-celled, 5-valved, many-seeded. Seeds scale-like.—Shrubs or small trees, of diverse habit and character, with chiefly alternate entire leaves, and large and showy flowers in umbelled clusters from large scaly-bracted terminal buds. (Ῥοδόδενδρον, *rose-tree*; the ancient name.)

§ 1. AZALEA. *Leaves deciduous, glandular-mucronate; stamens* (5 *to* 10) *and style more or less exserted and declined.*

* *Flower-buds of rather few and early caducous scales; corolla irregular, with short or hardly any tube, anteriorly divided to the base; the limb equalling the* 10 *stamens and style.*

1. **R. Rhodora**, Don. Young parts sparingly strigose-hairy (1–2° high); leaves oblong, pale, more or less pubescent; corolla hardly 1′ long, purplish-rose-color, bilabiate, with the posterior lip 3-lobed, the anterior of 2 oblong-linear and recurving nearly or quite distinct petals. (Rhodora Canadensis, L.)—Cool bogs, Lab. and Newf. to Q.

8. LEDUM, L. Labrador Tea.

Calyx 5-toothed, very small. Corolla of 5 obovate and spreading distinct petals. Stamens 5–10; anthers opening by terminal pores. Capsule 5-celled, splitting from the base upward, many-seeded; placentæ borne on the summit of the columella.—Low shrubs, with the alternate entire leaves clothed with rusty wool underneath, persistent, the margins revolute; herbage slightly fragrant when bruised. Flowers white, small, in terminal umbel-like clusters from large scaly buds; bracts or scales thin and caducous. (Λῆδον, the ancient Greek name of the Cistus.)

1. **L. latifolium**, Ait. Erect, 1–3° high; leaves oblong or linear-oblong (1–2′ long), mostly ½′ wide, very obtuse; stamens 5–7; capsule oblong, acutish.—Lab. to Pac., and northward, in cold bogs and mountain woods.

9. CHIMAPHILA, Pursh. Pipsissewa.

Petals 5, concave, orbicular, widely spreading. Stamens 10; filaments enlarged and hairy in the middle; anthers as in Pyrola, but more or less conspicuously 2-horned. Style very short, inversely conical, nearly immersed in the depressed summit of the globular ovary; stigma broad and orbicular, disk-shaped, the border 5-crenate. Capsule, etc., as in Pyrola, but splitting from the apex downward, the edges of the valves not woolly.—Low, nearly herbaceous plants, with long running underground shoots, and evergreen thick and shining leaves, somewhat whorled or scattered along the short ascending stems; the fragrant (white or purplish) flowers corymbed or umbelled on a terminal peduncle. (Name from *χεῖμα*, *winter*, and *φιλέω*, *to love*, in allusion to one of the popular names, viz., *Wintergreen.*)

1. **C. umbellata**, Nutt. Prince's Pine. Pipsissewa. Leafy, 4–10′ high; *leaves wedge-lanceolate*, sharply serrate, *not spotted*; peduncles 4–7-flowered; petals flesh-color; anthers violet.—Dry woods, Nova Scotia west to the Pacific. June. (Eu.)

10. MONESES, Salisb. One-flowered Pyrola.

Petals 5, widely spreading, orbicular. Filaments awl-shaped, naked; anthers as in Pyrola, but conspicuously 2-horned. Style straight, exserted; stigma large, peltate, with 5 narrow and conspicuous radiating lobes. Valves of the capsule naked. (Flowers occasionally tetramerous.) Scape 1-flowered. Otherwise as Pyrola; intermediate between it and Chimaphila. (Name formed of *μόνος*, *single*, and *ἥσις*, *delight*, from the pretty solitary flower.)

1. **M. grandiflora**, Salisb. A small perennial, with the rounded and veiny serrate thin leaves (6–9″ long) clustered at the ascending apex of creeping subterranean shoots; the 1–2-bracted scape (2–4′ high) bearing a white or rose-colored terminal flower 6″ wide. (M. uniflora, *Gray*.)—Deep cold woods, Labrador westward. June. (Eu.)

11. PYROLA, Tourn. WINTERGREEN. SHIN-LEAF.

Calyx 5-parted, persistent. Petals 5, concave and more or less converging, deciduous. Stamens 10; filaments awl-shaped, naked; anthers extrorse in the bud, but in the flower inverted by the inflexion of the apex of the filament, more or less 4-celled, opening by a pair of pores at the blunt or somewhat 2-horned base (by inversion the apparent apex). Style generally long; stigma 5-lobed or 5-rayed. Capsule depressed-globose, 5-lobed, 5-celled, 5-valved from the base upward (loculicidal); the valves cobwebby on the edges. Seeds minute, innumerable, resembling sawdust, with a very loose cellular-reticulated coat.—Low and smooth perennial herbs, with running subterranean shoots, bearing a cluster of rounded petioled evergreen root-leaves, and a simple raceme of nodding flowers, on an upright more or less scaly-bracted scape. (Name a diminutive of *Pyrus*, the Pear-tree, from some fancied resemblance in the foliage.)

* *Style straight, much narrower than the peltate 5-rayed stigma; petals and stamens erect and connivent; anthers not narrowed below the openings.*

1. **P. minor**, L. Scape 5–10′ high; *leaves roundish*, slightly crenulate, thickish, mostly longer than the margined petiole; flowers small, crowded, white or rose-color; calyx-lobes triangular-ovate, very much shorter than the nearly *globose corolla*; *style short and included.*—Cold woods, Lab., White Mts., L. Superior and northward.

2. **P. secunda**, L. Subcaulescent, 3–6′ high; *leaves ovate, thin*, longer than the petiole, scattered, *finely serrate*; racemes dense and spike-like, the numerous small (greenish-white) *flowers all turned to one side*, scarcely nodding; calyx-lobes ovate, very much shorter than the oblong-oval petals; *style long, exserted.*—Rich woods, Lab. to Pac., and far northward. July. (Eu.)

Var. **pumila**, Gray, is a smaller form, with rounded leaves 6″ or little more in diameter, and 3–8 flowered scape.—High peat-bogs, Lab., west and northward. July, August.

* * *Style strongly declined, the apex curved upward, longer than the connivent or spreading petals; stigma much narrower than the*

truncate excavated ring-like apex of the style ; anthers contracted below the openings, forming a short neck ; leaves denticulate or entire.

† *Petals and leaves orbicular to oblong, very obtuse.*

3. **P. chlorantha,** Swartz. *Leaves small* (1′ long), *roundish, thick, dull, shorter than the petiole ; scape few-flowered,* naked (5–8′ high) ; *calyx-lobes roundish-ovate, very short* ; the elliptical petals converging (greenish-white) ; *anther-cells contracted into a distinct neck* ; style little exserted.—Open woods, Lab., westward. June, July.

4. **P. elliptica,** Nutt. SHIN-LEAF. *Leaves thin and dull, elliptical or obovate-oval, longer than the margined petiole* ; raceme many-flowered ; *calyx-lobes ovate, acute, not one-fourth the length of the* obovate rather spreading (greenish-white) *petals ; anther-cells blunt.* —Rich woods, N. S., westward. June.

5. **P. rotundifolia,** L. *Leaves orbicular, thick, shining,* usually shorter than the petiole ; scape many-bracted (6–12′ high) ; raceme elongated, many-flowered ; *calyx-lobes lanceolate or oblong-lanceolate,* acutish, with somewhat spreading tips, *one half or one third the length of the* roundish-obovate rather spreading (chiefly white) *petals ; anther-cells nearly blunt.*—Damp or sandy woods, throughout the continent.

12. MONOTROPA, L. INDIAN PIPE. PINE-SAP.

Calyx of 2–5 lanceolate bract-like scales, deciduous. Corolla of 4 or 5 separate erect spatulate or wedge-shaped scale-like petals, which are gibbous or saccate at the base, and tardily deciduous. Stamens 8 or 10 ; filaments awl-shaped ; anthers kidney-shaped, becoming 1-celled, opening across the top. Style columnar ; stigma disk-like, 4–5-rayed. Capsule ovoid, 8–10-grooved, 4–5-celled, loculicidal ; the very thick placentæ covered with innumerable minute seeds, which have a very loose coat.—Low and fleshy herbs, tawny, reddish, or white, parasitic on roots, or growing on decomposing vegetable matter like a Fungus ; the clustered stems springing from a ball of matted fibrous rootlets, furnished with scales or bracts in place of leaves, 1–several-flowered ; the summit at first nodding, in fruit erect. (Name composed of *μόνος, one,* and *τρόπος, turn,* from the summit of the stem turned to one side.)

§ 1. MONOTROPA proper. *Plant inodorous, 1-flowered; calyx of 2–4 irregular scales or bracts; anthers transverse, opening equally by 2 chinks; style short and thick.*

1. **M. uniflora**, L. INDIAN PIPE. CORPSE-PLANT. Smooth, waxy-white (turning blackish in drying, 3–8′ high); stigma naked. —Dark and rich woods, nearly throughout the continent. June–August. (Asia.)

§ 2. HYPOPITYS. *Plant commonly fragrant; flowers several in a scaly raceme; the terminal one usually 5-merous, the rest 3–4-merous; bract-like sepals mostly as many as the petals; anthers opening by a continuous line into 2 very unequal valves; style longer than the ovary, hollow.*

2. **M. Hypopitys**, L. PINE-SAP. FALSE BEECH-DROPS. Somewhat pubescent or downy, tawny, whitish, or reddish (4–12′ high); pod globular or oval; stigma ciliate.—Oak and pine woods, from Ant. and N. S. west to Ont. June–August. (Eu.)

ORDER 42. PRIMULACEÆ (PRIMROSE FAMILY).

Herbs, with simple leaves, and regular perfect flowers, the stamens as many as the lobes of the monopetalous (rarely polypetalous) corolla and inserted opposite them (on the tube or base), *and a 1-celled ovary with a central free placenta rising from the base, bearing several or many seeds.*—Calyx free from the ovary, or in Samolus partly coherent. (Corolla none in Glaux.) Stamens 4 or 5, rarely 6 or 8. Style and stigma one. Seeds with a small embryo in fleshy albumen. Ovules amphitropous.

Tribe I. PRIMULEÆ. Ovary wholly free.

* Stemless; leaves all in a cluster from the root; capsule dehiscent by valves or teeth.

1. **Primula.** Corolla funnel-form or salver-shaped, open at the throat. Stamens included.

* * Stems leafy; corolla rotate; leaves entire.

† Capsule dehiscent vertically by valves or irregularly, mostly globose.

2. **Trientalis.** Corolla mostly 7-parted. Stem leafy only at the summit.
3. **Steironema.** Corolla 5-parted. Five slender staminodia between the fertile stamens.
4. **Lysimachia.** Corolla 5–6-parted or 5–6-petalled. Staminodia none. Leaves dotted.

1. PRIMULA, L. PRIMROSE. COWSLIP.

Calyx tubular, angled, 5-cleft. Corolla salver-shaped, enlarging above the insertion of the stamens; the 5 lobes often notched or

inversely heart-shaped. Stamens 5, included. Capsule many-seeded, splitting at the top into 5 valves or 10 teeth.—Low perennial herbs, producing a tuft of veiny leaves at the root, and simple scapes, bearing the flowers in an umbel. (Name a diminutive of *primus*, from the flowering of the true Primrose in early spring.)

1. **P. farinosa,** L. Bird's-eye Primrose. Scape 3–10′ high; leaves elliptical or obovate-lanceolate, denticulate, *the lower side* and the 3–20-flowered *involucre, etc., covered with a white mealiness,* at least when young; corolla pale lilac with a yellow eye.—Marit. Prov. to R. Mts. June, July. (Eu., Asia.)

2. TRIENTALIS, L. Chickweed-Wintergreen.

Calyx mostly 7-parted; the divisions linear-lanceolate, pointed. Corolla mostly 7-parted, spreading, flat, without tube. Filaments slender, united in a ring at the base; anthers oblong, revolute after flowering. Capsule few-seeded.—Low and smooth perennials, with simple erect stems, bearing a few alternate usually minute and scale-like leaves below, and a whorl of thin veiny leaves at the summit. Peduncles one or more, very slender, bearing a delicate white and star-shaped flower. (A Latin name, meaning the third part of a foot, alluding to the height of the plant.)

1. **T. Americana,** Pursh. Star-flower. Spreading by very slender elongated rootstocks; leaves elongated-lanceolate, tapering to both ends, petals finely pointed.—Damp cold woods, from Lab. to Sask. May.—Rootstocks often 1–2° long (*Hitchings*).

3. STEIRONEMA, Raf.

Calyx 5-parted. Corolla rotate, with no proper tube, deeply 5-parted, the sinuses rounded; divisions ovate, cuspidate-pointed, erose-denticulate above, each separately involute around its stamen. Filaments distinct or nearly so on the ring at base of corolla, alternating with 5 subulate staminodia; anthers linear. Capsule 10–20-seeded.—Leafy-stemmed perennials, glabrous except the ciliate petioles, not punctate, the leaves all opposite, but mostly in seeming whorls on the flowering branches. Peduncles slender, axillary, bearing yellow flowers. (From στεῖρος, *sterile*, and νῆμα, *thread*, referring to the staminodia.)

1. **S. ciliatum,** Raf. *Stem erect* (2–4° high); *leaves lanceolate-*

ovate (2–6′ long), tapering to an acute point, *rounded or heart-shaped at base*, all on long and fringed petioles; *corolla longer than the calyx.* (Lysimachia ciliata, *L.*)—Low grounds and thickets, common. July.

2. **S. lanceolatum,** Gray. *Stem erect* (10′–2° high); *leaves lanceolate, varying to oblong and linear, narrowed into a short margined petiole* or tapering base, or the lowest short and broad on long petioles. (Lysimachia lanceolata, *Walt.*)—Low grounds and thickets, Ont.

4. LYSIMACHIA, Tourn. Loosestrife.

Calyx 5–6-parted. Corolla rotate, the divisions entire, convolute in bud. Filaments commonly monadelphous at base; anthers oblong or oval; staminodia none. Capsule few–several-seeded.—Leafy-stemmed perennials, with herbage commonly glandular-dotted. (In honor of King *Lysimachus*, or from λύσις, *a release from*, and μάχη, *strife.*)

§ 1. LYSIMACHIA proper. *Corolla yellow, rotate, and very deeply parted, and with no teeth between the lobes; stamens more or less monadelphous, often unequal; leaves opposite or whorled, or some abnormally alternate.*

* *Flowers (small) in a virgate terminal raceme or in the upper axils; corolla dark-dotted or streaked; filaments conspicuously monadelphous, unequal.*

1. **L. quadrifolia,** L. Somewhat hairy; stem simple (1–2° high); *leaves whorled* in fours or fives (sometimes in twos, threes, or sixes, rarely only opposite or partly alternate), ovate-lanceolate; *flowers* on long capillary peduncles *from the axils of the leaves*; lobes of the corolla ovate-oblong.—Moist or sandy soil, N. B. to Ont. June.

2. **L. stricta,** Ait. Stems 1–2° high, often bearing oblong or moniliform bulblets in the axils; smooth, at length branched, very leafy; *leaves opposite* or rarely alternate, lanceolate, acute at each end; *flowers* on slender pedicels *in a long raceme* (5–12′), leafy at base; lobes of the corolla lance-oblong.—Low grounds, Newf. to Sask. June–Aug.

** *Flowers (rather large) solitary in the axils of ordinary leaves; corolla not dark-dotted nor streaked; filaments slightly monadelphous.*

3. **L. nummularia,** L. MONEYWORT. Smooth; stems trailing and creeping; leaves roundish, small, short-petioled; peduncles axillary, 1-flowered; divisions of the corolla broadly ovate, obtuse, longer than the lance-ovate calyx-lobes and stamens.—Escaped from gardens into damp ground, Newf. to Ont. July–Sept. (Nat. from Eu.)

§ 2. NAUMBURGIA. *Corolla very deeply 5- (or 6–7) parted into linear divisions (somewhat purplish-dotted), with a small tooth in each sinus; filaments distinct, equal; leaves opposite, the lowest scale-like.*

4. **L. thyrsiflora,** L. TUFTED LOOSESTRIFE. Smooth; stem simple (1–2° high); all but the lower leaves lanceolate, the axils of one or two middle pairs bearing short-peduncled head-like or spike-like clusters of small light yellow flowers.—Cold swamps, N. S. westward. June, July. (Eu.)

ORDER 43. APOCYNACEÆ (DOGBANE FAMILY).

Plants almost all with milky acrid juice, entire (chiefly opposite) leaves without stipules, regular 5-merous and 5-androus flowers; the 5 lobes of the corolla convolute and twisted in the bud; the filaments distinct, inserted on the corolla, and the pollen granular; calyx free from the two ovaries, which (in our genera) are distinct (forming follicles), though their styles or stigmas are united into one.—Seeds amphitropous or anatropous, with a large straight embryo in sparing albumen, often bearing a tuft of down (comose).—Chiefly a tropical family (of acrid-poisonous plants), represented in gardens by the Oleander and Periwinkle.

1. **Apocynum.** Seeds comose. Corolla bell-shaped, appendaged within. Filaments short, broad and flat. Calyx not glandular. Leaves opposite.

1. APOCYNUM, Tourn. DOGBANE. INDIAN HEMP.

Calyx 5-parted, the lobes acute. Corolla bell-shaped, 5-cleft, bearing 5 triangular appendages below the throat opposite the lobes. Stamens 5, on the very base of the corolla; filaments flat, shorter than the arrow-shaped anthers, which converge around the stigma, and are slightly adherent to it. Style none; stigma large, ovoid, slightly 2-lobed. Fruit of 2 long (2–7′) and slender follicles. Seeds comose, with a tuft of long silky down at the apex.—Peren-

nial herbs, with upright branching stems, opposite mucronate-pointed leaves, a tough fibrous bark, and small and pale cymose flowers on short pedicels. (Ancient name of the Dogbane, composed of *ἀπό, from*, and *κύων, a dog.*)

1. **A. androsæmifolium,** L. Spreading Dogbane. Smooth, or rarely soft-tomentose, branched above; *branches divergently forking; leaves ovate, distinctly petioled; cymes loose, spreading*, mostly longer than the leaves; *corolla* (pale rose-color, 4″ broad) *open-bell-shaped, with revolute lobes, the tube much longer than the ovate pointed divisions of the calyx.*—Borders of thickets; common. June, July.

2. **A. cannabinum,** L. Indian Hemp. Glabrous or more or less soft pubescent; stem and branches *upright or ascending* (2–3° high), terminated by *erect and close many-flowered cymes*, which are usually shorter than the leaves; leaves from oval to oblong and even lanceolate, short-petioled or sessile, with rounded or obscurely cordate base; *corolla* (greenish-white) *with nearly erect lobes, the tube not longer than the lanceolate divisions of the calyx.*—Moist grounds and banks of streams; common. Very variable. July, August.

Order 44. ASCLEPIADACEÆ (Milkweed Family).

Plants with milky juice, and opposite or whorled (rarely scattered) entire leaves; the follicular pods, seeds, anthers (connected with the stigma), sensible properties, etc., just as in the last family, from which they differ in the commonly valvate corolla, and in the singular connection of the anthers with the stigma, the cohesion of the pollen into wax-like or granular masses (pollinia), etc., as explained under the typical genus Asclepias.

Tribe I. CYNANCHEÆ. Anthers tipped with an inflexed or sometimes erect scarious membrane, the cells lower than the top of the stigma; pollinia suspended.

*Stems erect or merely decumbent.

1. **Asclepias.** Corolla reflexed, deeply 5-parted. Crown of 5-hooded fleshy bodies with an incurved horn rising from the cavity of each hood. Leaves usually opposite.

1. ASCLEPIAS, L. Milkweed. Silkweed.

Calyx 5-parted, persistent; the divisions small, reflexed. Corolla deeply 5-parted; the divisions valvate in the bud, reflexed, deciduous. *Crown* of 5 hooded bodies seated on the tube of stamens,

each containing an incurved horn. Stamens 5, inserted on the base of the corolla; filaments united in a tube which encloses the pistil; anthers adherent to the stigma, each with 2 vertical cells, tipped with a membranaceous appendage, each cell containing a flattened pear-shaped and waxy pollen-mass; the two contiguous pollen-masses of adjacent anthers, forming pairs which hang by a slender prolongation of their summits from 5 cloven glands that grow on the angles of the stigma (extricated from the cells by insects, and directing copious pollen-tubes into the point where the stigma joins the apex of the style). Ovaries 2, tapering into very short styles; the large depressed 5-angled fleshy stigmatic disk common to the two. Follicles 2, one of them often abortive, soft, ovate or lanceolate. Seeds anatropous, flat, margined, bearing a tuft of long silky hairs (*coma*) at the hilum, downwardly imbricated all over the large placenta, which separates from the suture at maturity. Embryo large, with broad foliaceous cotyledons in thin albumen.—Perennial upright herbs, with thick and deep roots; peduncles terminal or lateral and between the usually opposite petioles, bearing simple many-flowered umbels, in summer. (The Greek name of *Æsculapius*, to whom the genus is dedicated.)

§ 1. *Corneous anther-wings broadest and usually angulate-truncate and salient at base; horn conspicuous.*

* *Flowers orange-color; leaves mostly scattered; juice not milky.*

1. **A. tuberosa,** L. BUTTERFLY-WEED. PLEURISY-ROOT. Roughish-hairy (1–2° high); stems erect or ascending, very leafy, branching at the summit, and bearing usually numerous umbels in a terminal corymb; leaves from linear to oblong-lanceolate, sessile or slightly petioled; divisions of the corolla oblong (greenish-orange); hoods narrowly oblong, bright orange scarcely longer than the nearly erect and slender awl-shaped horns; pods hoary, erect on deflexed pedicels.—Dry fields, common, Ont.

* * *Corolla bright red or purple; follicles naked, fusiform, erect on the deflexed pedicels* (except in n. 2); *leaves opposite, mostly broad.*

† *Flowers small; hoods 1″ long, equalling the anthers; veins ascending.*

2. **A. incarnata,** L. SWAMP MILKWEED. Smooth, or nearly so, in the typical form, the stem with two downy lines above and on

the branches of the peduncles (2–3° high), very leafy; leaves oblong-lanceolate, acute or pointed, obtuse or obscurely heart-shaped at base; flowers rose-purple; hoods scarcely equalling the slender needle-pointed horn.—Swamps, common.

* * * *Flowers greenish, yellowish, white, or merely purplish-tinged; leaves opposite or whorled, or the upper rarely scattered.*

† *Follicles echinate with soft spinous processes, densely tomentose large (3–5′ long), ovate and acuminate, erect on deflexed pedicels; leaves large and broad, short petioled; umbels terminal and lateral.*

3. **A. Cornuti,** Decaisne. COMMON MILKWEED or SILKWEED. Stem tall and stout, finely soft-pubescent; *leaves* oval-oblong (4–8′ long), pale, *minutely downy beneath, as well as the peduncles,* etc.; corolla lobes dull purple to white, 3–4″ long; *hoods* rather longer than the anthers, *ovate, obtuse, with a tooth each side of the short, claw-like horn.*—Rich ground, everywhere.

ORDER 45. GENTIANACEÆ (GENTIAN FAMILY).

Smooth herbs, with a colorless bitter juice, opposite and sessile entire and simple leaves (except in Tribe II) *without stipules, regular flowers with the stamens as many as the lobes of the corolla, which are convolute (rarely imbricated and sometimes valvate) in the bud, a 1-celled ovary with 2 parietal placentæ, or nearly the whole inner face of the ovary ovuliferous; the fruit usually a 2-valved and septicidal many-seeded capsule.*—Flowers solitary or cymose. Calyx persistent. Corolla mostly withering persistent; the stamens inserted on its tube. Seeds anatropous, with a minute embryo in fleshy albumen. (Bitter-tonic plants.)

SUB-ORDER I. **Gentianeæ.** Leaves always simple and entire, sessile, never alternate. Æstivation of corolla never valvate.

* Lobes of corolla convolute in the bud.

† Style stout and persistent or none; anthers remaining straight.

1. **Gentiana.** Corolla funnel-form or bell-shaped, mostly plaited in the sinuses, without spurs or glands. Calyx 4–5-cleft.

2. **Halenia.** Corolla 4–5-cleft, campanulate, and 4–5-spurred at the base.

* * Lobes of corolla imbricate in the bud; no appendages.

SUB-ORDER II. **Menyantheæ.** Leaves all alternate and mostly petioled, sometimes trifoliolate or crenate. Æstivation of corolla induplicate-valvate. Marsh or aquatic perennials.

3. **Menyanthes.** Corolla bearded inside. Leaves 3-foliolate.

1. GENTIANA, Tourn. GENTIAN.

Calyx 4–5-cleft. Corolla 4–5-lobed, regular, usually with intermediate plaited folds, which bear appendages or teeth at the sinuses. Style short or none; stigmas 2, persistent. Capsule oblong, 2-valved; the innumerable seeds either borne on placentæ at or near the sutures, or in most of our species covering nearly the whole inner face of the pod.—Flowers solitary or cymose, showy, in late summer and autumn. (Name from *Gentius*, king of Illyria, who used some species medicinally.)

§ 1. GENTIANELLA. *Corolla (not rotate) destitute of extended plaits or lobes or teeth at the sinuses; root annual.*

* (FRINGED GENTIANS.) *Flowers large, solitary on long terminal peduncles, mostly 4-merous; corolla campanulate-funnel-form, its lobes usually fimbriate or erose, not crowned; a row of glands between the bases of the filaments. Autumn-flowering.*

1. **G. crinita,** Froel. Stem 1–2° high; *leaves lanceolate or ovate-lanceolate from a partly heart-shaped or rounded base*; lobes of the 4-cleft calyx unequal, ovate and lanceolate, as long as the bell-shaped tube of the blue corolla (2′ long), the *lobes* of which are *wedge-obovate, and strongly fringed around the summit*; *ovary lanceolate.*—Low grounds, Q. and Ont.

* * *Flowers smaller, 4–5-merous; corolla somewhat funnel-form or salver-form, its lobes entire; peduncles short or none, terminal and lateral on the acute-angled stem.*

2. **G. Amarella,** L. Stems 2–20′ high; leaves lanceolate to narrowly oblong, or the lowest obovate-spatulate, the margins minutely scabrous; calyx-lobes (4–5) foliaceous, lanceolate or linear; corolla mostly blue, ½′ long or more, *with a fimbriate crown at the base of the oblong acute lobes*; *capsule sessile.*—Var. **acuta,** Hook. f. Calyx almost 5-parted; crown usually of fewer and sometimes very few setæ.—Lab. to N. Vt. and N. Minn., west and northward.

§ 2. PNEUMONANTHE. *Corolla (funnel-form or salver-form) with thin-membranaceous toothed or lobed plaits in the sinuses; no crown nor glands; capsule stipitate; autumn-flowering perennials, the flowers large, sessile or short pedunculate and bibracteate.*

* *Anthers cohering in a ring or short tube; flowers in terminal and often axillary clusters.*

† *Calyx-lobes and bracts ciliolate-scabrous; seeds conspicuously winged; leaves rough-margined.*

3. G. **Andrewsii**, Griseb. CLOSED G. Stems upright, smooth; leaves ovate-lanceolate and lanceolate from a narrower base, gradually pointed; *calyx-lobes lanceolate to ovate*, recurved, *shorter than the top-shaped tube*, and much shorter than the more oblong and truncate mostly blue corolla, which is closed at the mouth, *its proper lobes obliterated*, the apparent lobes consisting of the broad fringe-toothed and notched appendages.—Moist ground, Q. and Ont. Corolla blue with white plaits, or sometimes all white.

2. HALENIA, Borkh. SPURRED GENTIAN.

Calyx 4–5-parted. Corolla short bell-shaped, 4–5-cleft, without folds or fringe, prolonged at the base underneath the erect lobes into spurs, which are glandular in the bottom. Stigmas 2, sessile, persistent on the oblong flattish capsule. Seeds rather numerous, oblong.—Small and upright herbs, with yellowish or purplish panicled-cymose flowers. (Named for *John Halen*, a German botanist.)

1. H. **deflexa**, Grisebach. Leafy annual or biennial (9–18′ high), simple or branched above; leaves 3–5-nerved, the lowest oblong-spatulate and petioled, the others oblong-lanceolate, acute; spurs cylindrical, obtuse, curved, descending, half the length of the acutely 4-lobed corolla.—Damp and cool woods, Lab. west, and northward.

3. MENYANTHES, Tourn. BUCKBEAN.

Calyx 5-parted. Corolla short funnel-form, 5-cleft, deciduous, the whole upper surface white-bearded, valvate in the bud with the margins turned inward. Style slender, persistent; stigma 2-lobed. Capsule bursting somewhat irregularly, many-seeded. Seed-coat hard, smooth, and shining.—A perennial alternate-leaved herb, with

a thickish creeping rootstock, sheathed by the membranous bases of the long petioles, which bear 3 oval or oblong leaflets; the flowers racemed on the naked scape (1° high), white or slightly reddish. (The ancient Theophrastian name, probably from *μήν*, *month*, and ἄνθος, *a flower*, some say from its flowering for about that time.)

1. **M. trifoliata**, L.—Bogs, Newf. and far north and westward. May, June. (Eu., Asia.)

ORDER 46. HYDROPHYLLACEÆ (WATERLEAF FAMILY).

Herbs, commonly hairy, with mostly alternate leaves, regular 5-merous and 5-androus flowers, in aspect between the foregoing and the next order; but the ovary entire and 1-celled with 2 parietal 4–many-ovuled placentæ, or rarely 2-celled by the union of the placentæ in the axis; style 2-cleft, or 2 separate styles; fruit a 2-valved 4–many-seeded capsule.—Seeds mostly reticulated or pitted. Embryo small in copious albumen. Flowers chiefly blue or white, in one-sided cymes or false racemes, which are mostly bractless and coiled from the apex when young, as in the Borage Family. A small order of plants of no marked properties; some cultivated for ornament.

Tribe I. HYDROPHYLLEÆ. Ovary and capsule 1-celled. Seeds pitted or reticulated; albumen cartilaginous. Leaves cut-toothed, lobed or pinnate. Style 2-cleft.

* Ovary lined with the dilated and fleshy placentæ, which enclose the ovules and seeds (in our plants only 4) like an inner pericarp.

1. **Hydrophyllum.** Stamens exserted; anthers linear. Calyx unchanged in fruit.

1. HYDROPHYLLUM, Tourn. WATERLEAF.

Calyx 5-parted, sometimes with a small appendage in each sinus, early open in the bud. Corolla bell-shaped, 5-cleft; the lobes convolute in the bud; the tube furnished with 5 longitudinal linear appendages opposite the lobes, which cohere by their middle, while their edges are folded inward, forming a nectariferous groove. Stamens and style mostly exserted; filaments more or less bearded; anthers linear. Ovary bristly-hairy (as is usual in the family); the 2 fleshy placentæ expanded so as to line the cell and nearly fill the cavity, soon free from the walls except at the top and bottom, each bearing a pair of ovules on the inner face. Capsule ripening 1–4 seeds, spherical.—Perennials, with petioled ample leaves, and white or pale blue cymose-clustered flowers. (Name formed of ὕδωρ, *water*, and φύλλον, *leaf*; of no obvious application.)

* *Calyx with minute if any appendages; rootstocks creeping, scaly-toothed.*

2. **H. Virginicum**, L. *Smoothish* (1–2° high); *leaves pinnately divided; the divisions 5–7, ovate-lanceolate or oblong, pointed,* sharply cut-toothed, the lowest mostly 2-parted, the uppermost confluent; *peduncles longer than the petioles* of the upper leaves, forked; calyx-lobes narrowly linear, bristly-ciliate; flowers 3″ long; anthers oblong-linear.—Rich woods, Q. westward. June–Aug.

ORDER 47. BORRAGINACEÆ (BORAGE FAMILY).

Chiefly rough-hairy herbs, with alternate entire leaves, and symmetrical flowers with a 5-parted calyx, a regular 5-lobed corolla, 5 stamens inserted on its tube, a single style and a usually deeply 4-lobed ovary (as in Labiatæ), *forming in fruit 4 seed-like 1-seeded nutlets, or separating into two 2-seeded or four 1-seeded nutlets.*—Albumen none. Cotyledons plano-convex; radicle pointing to the apex of the fruit. Stigmas 1 or 2. Calyx valvate, the corolla imbricated (in Myosotis convolute) in the bud. Flowers mostly on one side of the branches of a reduced cyme, imitating a spike or raceme, which is rolled up from the end, and straightens as the blossoms expand (circinate or scorpioid), often bractless. (A rather large family of innocent, mucilaginous, and slightly bitter plants; the roots of some species yielding a red dye.)

Tribe I. BORRAGINEÆ. Ovary deeply 4-parted, forming as many separate 1-seeded nutlets in fruit; style rising from the centre between them.

* Corolla and stamens regular.

† Nutlets armed, attached laterally; corolla short, closed by 5 scales.

1. **Cynoglossum.** Nutlets horizontally radiate, much produced downward, covered with barbed prickles.
2. **Echinospermum.** Nutlets erect or ascending, the margin or back armed with barbed prickles.

† † Nutlets unarmed, attached by the very base, ovoid, mostly smooth and shining.

‡ Scar flat, small. Racemes leafy-bracteate, except in n. 4.

3. **Myosotis.** Corolla short salver-form, its lobes rounded, and throat crested.
4. **Lithospermum.** Corolla salver-form to funnel-form, its rounded lobes spreading; the throat either naked or with low crests.

1. CYNOGLOSSUM, Tourn. HOUND'S-TONGUE.

Corolla funnel-form, the tube about equalling the 5-parted calyx, and throat closed with 5 obtuse scales; lobes rounded. Stamens

included. Nutlets depressed or convex, oblique, fixed near the apex to the base of the style, roughened all over with short barbed or hooked prickles.—Coarse herbs, with a strong scent and petioled lower leaves; the mostly panicled (so-called) racemes naked above, usually bracted at base. Fl. all summer. (Name from *κύων, a dog,* and *γλῶσσα, tongue*; from the shape and texture of the leaves.)

1. **C. officinale,** L. Common Hound's-Tongue. Biennial; *clothed with short soft hairs, leafy,* panicled above; upper leaves lanceolate, closely sessile by a rounded or slightly heart-shaped base; racemes nearly bractless; *corolla reddish-purple* (rarely white); nutlets flat on the broad upper face, somewhat margined.—Waste ground and pastures; a familiar and troublesome weed; the large nutlets adhering to the fleece of sheep, etc. (Nat. from Eu.)

2. **C. Virginicum,** L. Wild Comfrey. Perennial; *roughish with spreading bristly hairs*; stem simple, *few-leaved* (2–3° high), stem-leaves lanceolate-oblong, clasping by a deep heart-shaped base; *racemes few and corymbed, raised on long naked peduncles,* bractless; *corolla pale blue*; nutlets strongly convex.—Open woods; N. B. to Sask.

2. ECHINOSPERMUM, Lehm. Stickseed.

Corolla salver-form, short, imbricated in the bud, the throat closed with 5 short scales. Stamens included. Nutlets erect, fixed laterally to the base of the style or central column, triangular or compressed, the back armed all over or with 1–3 marginal rows of prickles which are barbed at the apex, otherwise naked.—Rough-hairy and grayish herbs, with small blue to whitish flowers in racemes or spikes; ours annuals or biennials, flowering all summer. (Name compounded of *ἐχῖνος, a hedgehog,* and *σπέρμα, seed.*)

* *Racemes panicled, leafy-bracteate at base; slender pedicels recurved or deflexed in fruit; calyx-lobes short, at length reflexed; biennial, not hispid.*

1. **E. Virginicum,** Lehm. Beggar's Lice. Stem 2–4° high; radical leaves round-ovate or cordate, slender-petioled; cauline (3–8′ long) ovate-oblong to oblong-lanceolate, acuminate at both ends; loosely paniculate racemes divaricate; pedicel and flower each a line long: *nutlets of the globose fruit equally short-glochidiate*

over the whole back. (Cynoglossum Morisoni, *DC.*)—Borders of woods and thickets, Q. to Sask.

3. MYOSOTIS, Dill. SCORPION-GRASS. FORGET-ME-NOT.

Corolla salver-form, the tube about the length of the 5-toothed or 5-cleft calyx, the throat with 5 small and blunt arching appendages opposite the rounded lobes; the latter convolute in the bud! Stamens included, on very short filaments. Nutlets smooth, compressed, fixed at the base; the scar minute.—Low and mostly soft-hairy herbs, with entire leaves, those of the stem sessile, and with small flowers in naked racemes, which are entirely bractless, or occasionally with one or two small leaves next the base, prolonged and straightened in fruit. Flowering through the season. (Name composed of *μύς, mouse,* and *οὖς, ὠτός, ear,* in allusion to the aspect of the short and soft leaves in some species; one popular name is MOUSE-EAR.)

* *Calyx open in fruit, its hairs appressed, none of them hooked or glandular.*

1. **M. palustris,** Withering. TRUE FORGET-ME-NOT. Perennial; stems ascending from an oblique creeping base (9–20′ high), loosely branched, smoothish; leaves rough-pubescent, oblong-lanceolate or linear-oblong; calyx-lobes much shorter than its tube; limb of corolla 3 or 4 lines broad, sky-blue with a yellow eye.—In wet ground, probably only escaped from cultivation. (Nat. from Eu.)

2. **M. laxa,** Lehm. Perennial from filiform subterranean shoots; stems very slender, decumbent; pubescence all appressed; leaves lanceolate-oblong or somewhat spatulate; calyx-lobes as long as its tube; limb of corolla 2 or 3″ broad, paler blue. (M. palustris, var. laxa, *Gray.*)—In water and wet ground, Newf. to Ont. (Eu.)

4. LITHOSPERMUM, Tourn. GROMWELL. PUCCOON.

Corolla funnel-form, or sometimes salver-shaped; the open throat naked, or with a more or less evident transverse fold or scale-like appendage opposite each lobe; the spreading limb 5-cleft, its lobes rounded. Anthers oblong, almost sessile, included. Nutlets ovate, smooth or roughened, mostly bony or stony, fixed by the base; scar nearly flat.—Herbs, with thickish and commonly red roots and sessile leaves; flowers solitary and as if axillary, or spiked and

leafy-bracted, sometimes dimorphous as to insertion of stamens and length of style. (Name formed of λίθος, *stone*, and σπέρμα, *seed*, from the hard nutlets.)

§ 1. *Nutlets tubercled or rough-wrinkled and pitted, gray and dull; throat of the (nearly white) corolla destitute of any evident folds or appendages.*

1. **L. arvense**, L. CORN GROMWELL. Minutely rough-hoary. annual or biennial; stems erect (6–12′ high); leaves lanceolate or linear, veinless; corolla scarcely longer than the calyx.—Sandy banks and roadsides, Q. and Ont. May–August. (Nat. from Eu.)

§ 2. *Nutlets smooth and shining, white like ivory; corolla greenish-white or pale-yellow, small, with 5 distinct pubescent scales in the throat; perennial.*

2. **L. officinale**, L. COMMON GROMWELL. Much branched above, erect (1–2° high); *leaves thinnish, broadly lanceolate, acute*, with a few distinct veins, rough above, soft-pubescent beneath; *corolla exceeding the calyx.*—Roadsides, Q. and Ont. (Nat. from Eu.)

ORDER 48. CONVOLVULACEÆ (CONVOLVULUS FAMILY).

Chiefly twining or trailing herbs, often with some milky juice, with alternate leaves (or scales) and regular 5-androus flowers; a calyx of 5 imbricated sepals; a 5-plaited or 5-lobed corolla convolute or twisted in the bud (imbricate in n. 3); *a 2-celled (rarely 3-celled) ovary (or in one tribe 2 separate pistils), with a pair of erect ovules in each cell, the cells sometimes doubled by a false partition between the seeds, so becoming 4-celled; the embryo large, curved or coiled in mucilaginous albumen.*—Fruit a globular 2–6-seeded capsule. Flowers mostly showy, on axillary peduncles; pedicels articulated, often 2-bracted. (Many are cultivated for ornament, and one, the Sweet Potato, for its edible farinaceous roots.)

Tribe I. CONVOLVULEÆ. Ovary entire. Leafy plants, mostly twiners.

1. **Ipomœa.** Style undivided, with stigma capitate or 2-3-globose.

2. **Convolvulus.** Style undivided or 2-cleft only at apex; stigmas 2, linear-filiform to subulate or ovate.

Tribe II. CUSCUTEÆ. Ovary entire. Leafless parasitic twining herbs, never green. Embryo filiform, coiled, without cotyledons.

3. **Cuscuta.** The only genus of the group.

1. IPOMŒA, L. Morning Glory.

Calyx not bracteate at base, but the outer sepals commonly larger. Corolla salver-form or funnel-form to nearly campanulate; the limb entire or slightly lobed. Style undivided, terminated by a single capitate or 2–3-globose stigma. Capsule globular, 4–6- (by abortion fewer) seeded, 2–4-valved. (Name, according to Linnæus, from ἴψ, *a Bindweed*, and ὅμοιος, *like*; but ἴψ is *a worm*.)

§ 1. IPOMŒA proper. *Corolla funnel-form or nearly campanulate, contorted in the bud; stamens and style not exserted.*

* (Morning Glory.) *Lobes of stigma and cells* 3, *sepals long and narrow, attenuate upward, mostly hirsute below; corolla purple, blue, and white.*

1. **I. purpurea.** Lam. Common Morning-Glory. Annual; stems retrorsely hairy; *leaves heart-shaped, acuminate, entire;* peduncles long, umbellately 3–5-flowered; calyx bristly-hairy below; corolla funnel-form (2′ long) purple, varying to white.—Escaped in cultivated grounds. (Trop. Amer.)

2. CONVOLVULUS, Tourn. Bindweed.

Corolla funnel-form to campanulate. Stamens included. Style undivided or 2-cleft only at the apex; stigmas 2, linear-filiform to subulate or ovate. Capsule globose, 2-celled, or imperfectly 4-celled by spurious partitions between the 2 seeds, or by abortion 1-celled, mostly 2–4-valved.—Herbs or somewhat shrubby plants, either twining, erect, or prostrate. (Name from *convolvo*, to entwine.)

§ 1. CALYSTEGIA. *Stigmas oval to oblong; calyx enclosed in 2 broad leafy bracts.*

1. **C. sepium,** L. Hedge Bindweed. Glabrous, or more or less pubescent; stem *twining or sometimes trailing extensively;* leaves triangular-halberd-shaped or arrow-shaped, acute or pointed, the basal lobes obliquely truncate and often somewhat toothed or sinuate-lobed; peduncles 4-angled; bracts commonly acute; corolla white or tinged with rose-color ($1\frac{1}{2}$ to 2′ long). (Calystegia sepium, *R. Br.*)—Moist alluvial soil, or along streams. (Eu., etc.)

Var. **Americanus,** Sims. Glabrous; corolla pink or rose-purple; bracts obtuse. (C. sepium of Am. authors mainly.)—Common, across the continent.

§ 2. *Stigmas filiform; no bracts at or near the base of the calyx.*

2. **C. arvensis**, L. BINDWEED. Perennial; stem procumbent or twining, and low; leaves ovate-oblong, arrow-shaped, with the lobes at the base acute; peduncles mostly 1-flowered; bracts minute, remote; corolla (9″ long) white or tinged with reddish.—Old fields, N. S. to Ont. (Eu.)

3. CUSCUTA, Tourn. DODDER.

Calyx 5- (rarely 4) cleft, or of 5 sepals. Corolla globular-urn-shaped, bell-shaped, or short-tubular, the spreading border 5- (rarely 4) cleft, imbricate. Stamens with a scale-like often fringed appendage at base. Ovary 2-celled 4-ovuled; styles distinct, or rarely united. Capsule mostly 4-seeded. Embryo thread-shaped, spirally coiled in the rather fleshy albumen, destitute of cotyledons; sometimes with a few alternate scales (belonging to the plumule); germination occurring in the soil.—Leafless annual herbs, with thread-like yellowish or reddish stems, bearing a few minute scales in place of leaves; on rising from the ground becoming entirely parasitic on the bark of herbs and shrubs on which they twine, and to which they adhere by means of suckers developed on the surface in contact. Flowers small, cymose-clustered, mostly white; usually produced late in summer and in autumn. (Name supposed to be of Arabic derivation.)

§ 1. *Stigmas capitate; capsule indehiscent.*

* *Calyx gamosepalous; ovary and capsule pointed, the latter enveloped or capped by the marcescent corolla; flowers in loose panicled cymes.*

† *Corolla-lobes obtuse, spreading.*

1. **C. Gronovii**, Willd. Stems coarse, often climbing high; corolla-lobes mostly shorter than the deeply campanulate tube; scales copiously fringed; *capsule globose, umbonate.*—Wet shady places, N. S. to L. of W. The commonest of our species. Flowers very variable in size and compactness of clusters.

ORDER 49. SOLANACEÆ (NIGHTSHADE FAMILY).

Herbs (or rarely shrubs), with colorless juice and alternate leaves, regular 5-merous and 5-androus flowers, on bractless pedicels; the

corolla imbricate or valvate in the bud, and mostly plaited; the fruit a 2-celled (rarely 3–5-celled) many-seeded capsule or berry.—Seeds campylotropous or amphitropous. Embryo mostly slender and curved in fleshy albumen. Calyx usually persistent. Stamens mostly equal, inserted on the corolla. Style and stigma single. Placentæ in the axis, often projecting far into the cells. (Foliage rank-scented, and with the fruits mostly narcotic, often very poisonous, while some are edible.)—A large family in the tropics, but very few indigenous in our district.

* Corolla wheel-shaped, 5-parted or 5-lobed; the lobes valvate and their margins usually turned inward in the bud. Anthers connivent. Fruit a berry.

1. **Solanum.** Anthers opening by pores or chinks at the tip.

* * Corolla various, not wheel-shaped, nor valvate in the bud. Anthers separate.

† Fruit a berry, enclosed in the bladdery-inflated calyx. Corolla widely expanding.

2. **Physalis.** Calyx 5-cleft. Corolla 5-lobed or nearly entire. Berry juicy, 2-celled.

1. SOLANUM, Tourn. NIGHTSHADE.

Calyx and wheel-shaped corolla 5-parted or 5-cleft (rarely 4–10-parted), the latter plaited in the bud, and valvate or induplicate. Stamens exserted; filaments very short; anthers converging around the style, opening at the tip by two pores or chinks. Berry usually 2-celled.—Herbs, or shrubs in warm climates, the larger leaves often accompanied by a smaller lateral (rameal) one; the peduncles also mostly lateral and extra-axillary.—A vast genus, chiefly in warmer regions, including the POTATO (S. TUBEROSUM) and the EGG-PLANT (S. MELONGENA); while the TOMATO (LYCOPERSICUM ESCULENTUM) is closely related. (Name of unknown derivation.)

* *Not prickly; anthers blunt; flowers and globose naked berries small.*

† *Perennial, climbing or twining.*

1. **S. dulcamara,** L. BITTERSWEET. More or less pubescent; leaves ovate-heart-shaped, the upper halberd-shaped, or with two ear-like lobes or leaflets at base; flowers (purple or blue) in small cymes; berries oval, red.—Moist banks and around dwellings. June–September. (Nat. from Eu.)

2. **S. nigrum,** L. COMMON NIGHTSHADE. Low, much branched and often spreading, nearly glabrous, rough on the angles; *leaves ovate, wavy-toothed*; *flowers* white, *in small umbel-like lateral clusters*, drooping; *calyx spreading*; filaments hairy; *berries* globu-

lar, *black*.—Shaded grounds and fields; common, appearing as if introduced, but a cosmopolite. July–Sept.

2. PHYSALIS, L. GROUND CHERRY.

Calyx 5-cleft, reticulated and enlarging after flowering, at length much inflated and enclosing the 2-celled globular (edible) berry. Corolla between wheel-shaped and funnel-form, the very short tube marked with 5 concave spots at the base; the plaited border somewhat 5-lobed or barely 5–10-toothed. Stamens 5, erect; anthers separate, opening lengthwise.—Herbs (in this country), with the leaves often unequally in pairs, and the 1-flowered nodding peduncles extra-axillary; flowering through the summer. (Name *φυσαλίς, a bladder*, from the inflated calyx.)

* *Corolla large, white or tinged with blue, without dark centre, with almost entire border; pubescence simple.*

1. **P. grandiflora,** Hook. Clammy-pubescent, erect; leaves lance-ovate, pointed, entire or nearly so; corolla 1–2′ wide when expanded, and with a woolly ring in the throat; fruiting calyx globular, apparently nearly filled by the berry.—Q. to Sask.

* * *Corolla lurid greenish-white or yellow, mostly with dark centre, 3–10″ broad.*

† *Strong-scented, villous or pubescent with viscid or glandular simple hairs; fruiting calyx ovate-pyramidal, carinately 5-angled, closed, loosely enveloping the green or yellow berry; leaves ovate or cordate.*

2. **P. Virginiana,** Mill. *Perennial,* diffusely much branched and widely spreading, or at first erect; leaves sometimes oblong, repand or obtusely toothed, rarely entire; *corolla 9–12″ broad,* 5-angled or 5–10-toothed; *anthers yellow.* (P. viscosa, *Gray*, Man., not *L.*)—Light or sandy soils, Ont. and Minn.

ORDER 50. SCROPHULARIACEÆ (FIGWORT FAMILY).

Chiefly herbs (rarely trees), with didynamous stamens (or perfect stamens often only 2, rarely 5) inserted on the tube of the 2-lipped or more or less irregular corolla, the lobes of which are imbricated in the bud; fruit a 2-celled and usually many-seeded capsule, with the placentæ in the axis; seeds anatropous, or amphitropous, with a

small embryo in copious albumen.—Style single; stigma entire or 2-lobed. Leaves and inflorescence various; but the flowers not terminal in any genuine representatives of the order.—A large order of bitterish plants, some of them narcotic-poisonous.

1. ANTIRRHINIDEÆ. Upper lip or lobes of the corolla covering the lower in the bud (with occasional exceptions in Mimulus, etc.) Capsule usually septicidal.

Tribe I. VERBASCEÆ. Corolla rotate. Flowers racemose. Leaves alternate.

1. **Verbascum.** Stamens 5, all with anthers, and 3 or all with bearded filaments.

Tribe II. ANTIRRHINEÆ. Corolla tubular, with a spur or sac at the base below, the throat usually with a palate. Capsule opening by chinks or holes. Flowers in simple racemes or axillary. Lower leaves usually opposite or whorled. Stamens 4.

2. **Linaria.** Corolla spurred at base; the palate seldom closing the throat.

Tribe III. CHELONEÆ. Corolla tubular, or 2-lipped, not spurred nor saccate below. Capsule 2–4-valved. Leaves opposite. Inflorescence usually compound, of small axillary spiked or racemed or umbel-like clusters or cymes, or when reduced to a single flower the peduncle mostly 2-bracteate. Stamens 4, and usually a rudiment of the fifth.

3. **Scrophularia.** Corolla inflated, globular or oblong, with four erect lobes and one spreading one. Rudiment of the sterile stamen a scale on the upper lip.

4. **Chelone.** Corolla tubular inflated above. Sterile stamen shorter than the others. Anthers very woolly. Seeds winged.

Tribe IV. GRATIOLEÆ. Corolla tubular, not saccate nor spurred. Capsule 2-valved. Flowers solitary in the axils of bracts or leaves; peduncles naked. Leaves all or the lower ones opposite. No trace of a fifth stamen.

* Stamens 4, all anther-bearing and similar.

5. **Mimulus.** Calyx prismatic, 5-angled, 5-toothed. Corolla elongated.

II. RHINANTHIDEÆ. Under lip or the lateral lobes of the corolla covering the upper in the bud. Capsule commonly loculicidal.

Tribe V. DIGITALEÆ. Corolla wheel-shaped, salver-shaped, or bell-shaped. Stamens 2 or 4, not approaching in pairs nor strongly didynamous; anthers 2-celled.

6. **Veronica.** Calyx 4- (rarely 3–5) parted. Corolla wheel-shaped or salver-shaped, almost regular. Stamens 2. Leaves chiefly opposite or whorled. Flowers racemed.

Tribe VI. GERARDIEÆ. Corolla with a spreading and slightly unequal 5-lobed limb. Stamens 4, approximate in pairs. Leaves opposite, or the uppermost alternate.

* Corolla bell-shaped to funnel-form; anthers 2-celled.

7. **Gerardia.** Stamens strongly unequal, included.

Tribe VII. EUPHRASIÆ. Corolla tubular, obviously 2-lipped; the upper lip narrow, erect or arched, enclosing the 4 usually strongly didynamous stamens.

* Anther-cells equal. Capsule many–several-seeded.

8. **Pedicularis.** Calyx not inflated. Capsule ovate or sword-shaped; seeds wingless.

** Anther-cells equal. Capsule 1–4-seeded.

9. **Melampyrum.** Calyx 4-cleft. Ovary 2-celled, 4-ovuled. Capsule flat, oblique.

1. VERBASCUM, L. Mullein.

Calyx 5-parted. Corolla 5-lobed, open or concave, wheel-shaped; the lobes broad and rounded, a little unequal. Stamens 5; all the filaments, or the 3 upper, woolly. Style flattened at the apex. Capsule globular, many-seeded.—Tall and usually woolly biennial herbs, with alternate leaves, those of the stem sessile or decurrent. Flowers in large terminal spikes or racemes, ephemeral; in summer. (The ancient Latin name, altered from *Barbascum.*)

1. **V. Thapsus,** L. Common Mullein. *Densely woolly throughout; stem tall and stout, simple,* winged by the decurrent bases of the oblong acute leaves; *flowers* (yellow, very rarely white) *in a prolonged and very dense cylindrical spike;* lower stamens usually beardless.—Fields, a common weed. (Nat. from Eu.)

2. **V. Blattaria,** L. Moth M. *Green and smoothish, slender;* lower leaves petioled, oblong, doubly serrate, sometimes lyre-shaped, the upper partly clasping; *raceme loose*; filaments all bearded with violet wool.—Roadsides, Ont. Corolla either yellow, or white with a tinge of purple. (Nat. from Eu.)

2. LINARIA, Tourn. Toad-Flax.

Calyx 5-parted. Corolla personate, with the prominent palate often nearly closing the throat, spurred at base on the lower side. Stamens 4. Capsule thin, opening below the summit by one or two pores or chinks. Seeds many.—Herbs, with at least all the upper leaves alternate (in ours); fl. in summer. (Name from *Linum*, the Flax, which the leaves of some species resemble.)

* *Slender glabrous annual or biennial; leaves linear, entire and alternate (or smaller, oblong, and opposite on procumbent shoots); small blue flowers in a naked terminal raceme.*

1. **L. Canadensis,** Dumont. Flowering stems nearly simple (6–30′ high); leaves flat (1–2″ wide); pedicels erect, not longer than the filiform curved spur of the corolla.—Sandy soil, common.

** *Perennial, erect (1–3° high), glabrous, with narrow entire and alternate pale leaves, and yellow flowers in a terminal raceme.*

2. **L. vulgaris**, Mill. RAMSTED. BUTTER AND EGGS. Leaves linear or nearly so, extremely numerous; raceme dense; corolla 1′ long or more, including the slender subulate spur; seeds winged.—Fields and roadsides, N.S. to Ont. (Nat. from Eu.)

3. SCROPHULARIA, Tourn. FIGWORT.

Calyx deeply 5-cleft. Corolla with a somewhat globular tube; the 4 upper lobes of the short border erect (the two upper longer), the lower spreading. Stamens 4, declined, with the anther-cells transverse and confluent into one; the fifth stamen a scale-like rudiment at the summit of the tube of the corolla. Capsule many-seeded.—Rank herbs, with mostly opposite leaves, and small greenish-purple or lurid flowers in loose cymes, forming a terminal narrow panicle. (So called because a reputed remedy for *scrofula.*)

1. **S. nodosa**, L., var. **Marilandica**, Gray. Smooth perennial (3–5° high); stem 4-sided; leaves ovate, oblong, or the upper lanceolate, acuminate, cut-serrate, rounded or rarely heart-shaped at base.—Damp grounds, Q. and Ont. (Eu., Asia, the type.)

4. CHELONE, Tourn. TURTLE-HEAD. SNAKE-HEAD.

Calyx of 5 distinct imbricated sepals. Corolla inflated-tubular, with the mouth a little open; upper lip broad and arched, keeled in the middle, notched at the apex; the lower woolly-bearded in the throat, 3-lobed at the apex, the middle lobe smallest. Stamens 4, with woolly filaments and very woolly heart-shaped anthers, and a fifth sterile filament smaller than the others. Seeds many, wing-margined.—Smooth perennials, with upright branching stems, opposite serrate leaves, and large white or purple flowers, which are nearly sessile in spikes or clusters, and closely imbricated with round-ovate concave bracts and bractlets. (Name from *χελωνη, a tortoise*, the corolla resembling in shape the head of a reptile.)

1. **C. glabra**, L. A foot or two (or even 6–7°) high; *leaves narrowly to rather broadly lanceolate* (4–5′ long, 4–12″ wide), gradually acuminate, serrate with sharp appressed teeth, narrowed at base usually into a very short petiole; *bracts not ciliate; corolla white, or barely tinged with rose.*—Wet places, Newf. westward.

5. MIMULUS, L. Monkey-flower.

Calyx prismatic, 5-angled, 5-toothed, the upper tooth largest. Corolla tubular; upper lip erect or reflexed-spreading, 2-lobed; the lower spreading, 3-lobed. Stamens 4. Stigma 2-lobed, the lobes ovate. Seeds numerous.—Herbs, with opposite leaves, and mostly handsome flowers on solitary axillary and bractless peduncles. (Diminutive of *mimus*, a buffoon, from the grinning corolla.)

* *Erect from a perennial root, glabrous; leaves feather-veined; corolla violet-purple.*

1. **M. ringens**, L. Stem square (1–2° high); *leaves oblong or lanceolate, pointed, clasping* by a heart-shaped base, serrate; peduncles longer than the flower; calyx-teeth taper-pointed, nearly equal; corolla personate.—Wet places, C.B. to Sask; common. July–Sept.—Flower 1–1½′ long, rarely white.

6. VERONICA, L. Speedwell.

Calyx 4- (rarely 3–5) parted. Corolla wheel-shaped or salver-shaped, the border 4-parted (rarely 5-parted); the lateral lobes or the lower ones commonly narrower than the others. Stamens 2, one each side of the upper lobe of the corolla, exserted; anther-cells confluent at the apex. Style entire; stigma single. Capsule flattened, obtuse or notched at the apex, 2-celled, few–many-seeded. —Chiefly herbs; leaves mostly opposite or whorled; flowers blue, flesh-color, or white. (Derivation doubtful; perhaps the flower of *St. Veronica.*)

§ 1. LEPTANDRA. *Tall perennials, with mostly whorled leaves; racemes terminal, dense, spiked; bracts very small; tube of the corolla longer than its limb and much longer than the calyx; both sometimes 5-cleft.*

1. **V. Virginica**, L. Culver's-root. Culver's Physic. Smooth or rather downy; stem simple, straight (2–6° high); leaves whorled in fours to sevens, short-petioled, lanceolate, pointed, finely serrate; spikes panicled; corolla small, nearly white; stamens much exserted; capsule oblong-ovate, not notched, opening by 4 teeth at the apex, many seeded.—Common; July, Aug.

§ 2. VERONICA proper. *Corolla wheel-shaped; capsule more or less notched, strongly flattened except in* n. *2 and 3; low herbs.*

* *Perennials, stoloniferous or rooting at base, with opposite usually serrate leaves; racemes axillary, mostly opposite; corolla pale blue.*

† *Capsule turgid, orbicular, many-seeded.*

2. **V. Anagallis**, L. WATER SPEEDWELL. Smooth, creeping and rooting at base, then erect; *leaves sessile, most of them clasping by a heart-shaped base, ovate-lanceolate*, acute, serrate or entire (2–3′ long); pedicels spreading; corolla pale blue with purple stripes; capsule slightly notched.—Brooks and ditches, N. S. west to the Rocky Mts. June–Aug. (Eu., Asia.)

3. **V. Americana**, Schweinitz. AMERICAN BROOKLIME. Smooth, decumbent at base, then erect (8–15′ high); *leaves mostly petioled, ovate or oblong*, serrate, thickish, truncate or slightly heart-shaped at base; the slender pedicels spreading.—Brooks and ditches, common. June–Aug.

† † *Capsule strongly flattened, several-seeded.*

4. **V. scutellata**, L. MARSH SPEEDWELL. *Smooth*, slender and weak (6–12′ high); *leaves sessile, linear, acute, remotely denticulate; racemes several, very slender* and zigzag; *flowers few and scattered*, on elongated spreading or reflexed pedicels; capsule very flat, much broader than long, notched at both ends or didymous.—Bogs, common. June–Aug. (Eu., Asia.)

5. **V. officinalis**, L. COMMON SPEEDWELL. *Pubescent;** stem *prostrate*, rooting at base; *leaves short-petioled, obovate-elliptical or wedge-oblong, obtuse, serrate; racemes densely many-flowered*; pedicels shorter than the calyx; capsule obovate-triangular, broadly notched.—Dry hills and open woods, N. S. to Ont. July. (Eu., Asia.)

** *Leaves opposite; flowers in a terminal raceme; the lower bracts leaf-like; capsules flat, several-seeded. Perennials (mostly turning blackish in drying.)*

6. **V. serpyllifolia**, L. THYME-LEAVED SPEEDWELL. Much branched at the creeping base, *nearly smooth;* branches ascending and simple (2–4′ high); *leaves ovate or oblong*, obscurely crenate, *the lowest petioled* and rounded, the upper passing into lanceolate

bracts; *raceme loose*; corolla whitish, or pale blue, with deeper stripes; capsule rounded, broader than long, obtusely notched.—Roadsides and fields, common; introduced and indigenous. May–July. (Eu., Asia.)

7. GERARDIA, L.

Calyx bell-shaped, 5-toothed or 5-cleft. Corolla campanulate-funnel-form, or somewhat tubular, swelling above, with 5 more or less unequal spreading lobes, the 2 upper usually rather smaller and more united. Stamens 4, strongly didynamous, included, hairy; anthers approaching by pairs, 2-celled, the cells parallel, often pointed at base. Style elongated, mostly enlarged and flattened at the apex. Capsule globular or ovate, pointed, many-seeded.—Erect branching herbs (more or less root-parasitic); stem-leaves opposite, or the upper alternate, the uppermost reduced to bracts and subtending 1-flowered peduncles, which often form a raceme or spike. Flowers showy, purple or yellow; in late summer and autumn. (Dedicated to the celebrated herbalist, *John Gerarde.*)

§ 1. GERARDIA proper. *Corolla purple or rose-color (rarely white); calyx-teeth short; anthers alike, nearly pointless, pubescent; cauline leaves linear or narrower, entire.*

* *Annuals; herbage blackish in drying* (except n. 9).

† *Pedicels little if at all longer than the calyx and capsule.*

1. **G. purpurea**, L. Purple Gerardia. Stem (1–2° high) with long and rigid widely spreading branches; *leaves linear, acute, rough-margined*; flowers large (1′ long), bright purple, often downy; *pedicels shorter than the calyx, mainly opposite; calyx-teeth sharp-pointed*, from very short to about half as long as the tube.—Low grounds, mainly near the coast and in the region of the Great Lakes. Very variable.

† † *Pedicels usually exceeding the corolla; woolly anthers cuspidate at base.*

2. **G. tenuifolia**, Vahl. Slender G. *Leaves narrowly linear*, acute, the floral ones mostly like the others; *calyx-teeth very short, acute; capsule globular, not exceeding the calyx*; corolla about ½′ long.—Low or dry ground, common.

8. PEDICULARIS, Tourn. Lousewort.

Calyx various. Corolla strongly 2-lipped; the upper lip arched, flattened, often beaked at the apex; the lower erect at base, 2-crested above, 3-lobed; lobes commonly spreading, the lateral ones rounded and larger. Stamens 4, under the upper lip; anthers transverse; the cells equal, pointless. Capsule ovate or lanceolate, mostly oblique, several-seeded.—Perennial herbs, with chiefly pinnatifid leaves, the floral bract-like, and rather large flowers in a spike. (Name from *pediculus*, a louse; of no obvious application.)

1. **P. Canadensis**, L. Common Lousewort. Wood Betony. Hairy; stems simple, clustered (5–12′ high); *leaves scattered, the lowest pinnately parted, the others half-pinnatifid*; spike short and dense; *calyx split in front, otherwise almost entire*, oblique; *upper lip of the* (dull greenish-yellow and purplish) *corolla hooded, incurved*, 2-toothed under the apex; capsule *flat, somewhat sword-shaped.*—Copses and banks, common. May–July.

9. MELAMPYRUM, Tourn. Cow-Wheat.

Calyx bell-shaped, 4-cleft; the taper lobes sharp-pointed. Tube of corolla cylindrical, enlarging above; upper lip arched, compressed, straight in front; the lower erect-spreading, biconvex, 3-lobed at the apex. Stamens 4, under the upper lip; anthers approximate, oblong, nearly vertical, hairy; the equal cells minutely pointed at base. Ovary with 2 ovules in each cell. Capsule flattened, oblique, 1–4-seeded.—Erect branching annuals, with opposite leaves, the lower entire, the upper mostly toothed at base. Flowers solitary in the upper axils. (Name from μέλας, *black*, and πυρός, *wheat*; from the color of the seeds of some species as they appear mixed with grain.)

1. **M. Americanum**, Michx. Leaves lanceolate, short-petioled, the floral ones like the lower, or truncate at base and beset with a few bristly teeth; calyx-teeth linear-awl-shaped, not half the length of the slender tube of the pale greenish-yellow corolla (5″ long).—Open woods; common, from N.S. westward. June–Sept.

Order 51. OROBANCHACEÆ (Broom-rape Family).

Herbs destitute of green foliage (root-parasites), monopetalous, didynamous, the ovary one-celled with 2 or 4 parietal placentæ; pod

very many-seeded; seeds minute, with albumen and a very minute embryo.—Calyx persistent, 4–5-toothed or parted. Corolla tubular, more or less 2-lipped, ringent, persistent and withering; upper lip entire or 2-lobed, the lower 3-lobed. Stamens 4, didynamous, inserted on the tube of the corolla; anthers 2-celled, persistent. Ovary free, ovoid, pointed with a long style; stigma large. Capsule 1-celled, 2-valved; each valve bearing on its face one placenta or a pair. Seeds very numerous, minute. Low, thick or fleshy herbs, bearing scales in place of leaves, lurid yellowish or brownish throughout. Flowers solitary or spiked.

* Flowers of two sorts, scattered along slender panicled branches.

1. **Epiphegus.** Upper flowers sterile, with a tubular corolla; the lower fertile, with the corolla minute and not expanding. Bracts inconspicuous.

* * Flowers all alike and perfect; stems mostly simple.

2. **Aphyllon.** Flowers pedicellate, sometimes subsessile and thyrsoid spicate. Calyx regularly 5-cleft. Corolla somewhat 2-lipped. Stamens included.

1. EPIPHEGUS, Nutt. Beech-drops. Cancer-root.

Flowers racemose or spiked, scattered on the branches; the upper sterile, with a long tubular corolla and long filaments and style; the lower fertile, with a very short corolla which seldom opens, but is forced off from the base by the growth of the pod; stamens and style very short. Calyx 5-toothed. Stigma capitate, a little 2-lobed. Capsule 2-valved at the apex, with 2 approximate placentæ on each valve.—Herbs slender, purplish or yellowish-brown, much branched, with small scattered scales, 6–12′ high. (Name from ἐπί, *upon*, and φηγός, *the Beech*, because it grows on the roots of that tree.)

1. **E. Virginiana,** Bart. Corolla of the upper (sterile) flowers whitish and purple, 6–8″ long, curved, 4-toothed.—Common under Beech-trees, parasitic on their roots; N.S. to Ont. Aug.–Oct.

2. APHYLLON, Mitchell. Naked Broom-rape.

Flowers perfect, pedicellate, sometimes subsessile and thyrsoid-spicate. Calyx 5-cleft, regular. Corolla somewhat 2-lipped; the upper lip more or less spreading and 2-lobed, the lower spreading, 3-lobed. Stamens included. Stigma broadly 2-lipped or crateriform. Capsule with 4 placentæ, equidistant or contiguous in pairs. Plants brownish or whitish. Flowers (purplish or yellowish) and

naked scapes minutely glandular-pubescent. (Name from α privative and φύλλον, *foliage*, alluding to the naked stalks.)

* *Flowers solitary on long naked scapes or peduncles, without bractlets; corolla with a long curved tube and spreading 5-lobed limb.*

1. **A. uniflorum**, Gray. ONE-FLOWERED CANCER-ROOT. *Stem subterranean or nearly so, very short*, scaly, often branched, each branch sending up 1–3 slender one-flowered scapes (3–5′ high); *divisions of the calyx lance-awl-shaped*, half the length of the corolla, which is 1′ long, with two yellow bearded folds in the throat, and obovate lobes.—Damp woodlands, Newf., west to the Pacific.—April–July.

ORDER 52. VERBENACEÆ (VERVAIN FAMILY).

Herbs or shrubs, with opposite leaves, more or less 2-lipped or irregular corolla, and didynamous stamens, the 2–4-celled (in Phryma 1-celled) *fruit dry or drupaceous, usually splitting when ripe into as many 1-seeded indehiscent nutlets*; differing from the following order in the ovary not being 4-lobed, the style therefore terminal, and the plants seldom aromatic or furnishing a volatile oil.—Seeds with a straight embryo and little or no albumen.

Tribe I. VERBENEÆ. Ovary 2–4-celled, with an erect anatropous ovule in each cell.

1. **Verbena.** Flowers in spikes or heads. Calyx tubular. Fruit splitting into 4 nutlets.

Tribe II. PHRYMEÆ. Ovary 1-celled; ovule erect, orthotropous.

2. **Phryma.** Flowers in slender spikes. Calyx cylindrical, 2-lipped. Fruit an achene.

1. VERBENA, Tourn. VERVAIN.

Calyx tubular, 5-toothed, one of the teeth often shorter than the others. Corolla tubular, often curved, salver-form; the border somewhat unequally 5-cleft. Stamens included; the upper pair occasionally without anthers. Style slender; stigma mostly 2-lobed. Fruit splitting into 4 seed-like nutlets.—Flowers sessile, in single or often panicled spikes, bracted; produced all summer. (The Latin name for any sacred herb; derivation obscure.)

§ 1. *Anthers not appendaged; flowers small, in narrow spikes.*

* *Spikes filiform, with flowers or at least fruits scattered, naked, the inconspicuous bracts shorter than the calyx.*

1. **V. urticæfolia**, L. WHITE V. Perennial, from minutely pubescent to almost glabrous, rather tall (3–5° high); *leaves oval or oblong-ovate, acute, coarsely serrate, petioled*; spikes at length much elongated, loosely panicled; flowers very small, *white.*—Waste or open grounds. (Trop. Am.)

** *Spikes thicker or densely flowered; the fruits crowded, mostly overlapping each other; bracts inconspicuous, not exceeding the flowers; perennial.*

2. **V. angustifolia**, Michx. Low (6–18′ high), often simple; *leaves narrowly lanceolate, tapering to the base, sessile, roughish,* slightly toothed; spikes few or single; the purple flowers crowded, larger than in the next.—Dry or sandy ground, Q. and Ont.

3. **V. hastata**, L. BLUE VERVAIN. Tall (4–6° high); *leaves lanceolate or oblong-lanceolate,* taper-pointed, cut-serrate, *petioled, the lower often lobed and sometimes halberd-shaped* at base; *spikes linear, erect,* corymbed or panicled; flowers blue.—Waste grounds and roadsides; common.

2. PHRYMA, L. LOPSEED.

Calyx cylindrical, 2-lipped; the upper lip of 3 bristle-awl-shaped teeth; the lower shorter, 2-toothed. Corolla 2-lipped; upper lip notched; the lower much larger, 3-lobed. Stamens included. Style slender; stigma 2-lobed. Fruit dry, in the bottom of the calyx, oblong, 1-celled and 1-seeded. Seed orthotropous. Cotyledons convolute round their axis.—A perennial herb, with slender branching stems, and coarsely toothed ovate leaves, the lower long-petioled; the small opposite flowers in elongated and slender terminal spikes, strictly reflexed in fruit. Corolla purplish or rose-color. (Derivation of the name unknown.)

1. **P. Leptostachya**, L. Plant 2–3° high; leaves 3–5′ long, thin; calyx strongly ribbed and closed in fruit, the long slender teeth hooked at the tip.—Moist and open woods, common. (E. Asia.)

ORDER 53. LABIATÆ (MINT FAMILY).

Chiefly herbs, with square stems, opposite aromatic leaves, more or less 2-lipped corolla, didynamous or diandrous stamens, and a deeply 4-lobed ovary, which forms in fruit 4 little seed-like nutlets or achenes,

surrounding the base of the single style in the bottom of the persistent calyx, each filled with a single erect seed.—Nutlets smooth or barely roughish and fixed by their base, except in the first tribe. Albumen mostly none. Embryo straight (except in Scutellaria); radicle at the base of the fruit. Upper lip of the corolla 2-lobed or sometimes entire; the lower 3-lobed. Stamens inserted on the tube of the corolla. Style 2-lobed at the apex. Flowers axillary, chiefly in cymose clusters, these often aggregated in terminal spikes or racemes. Foliage mostly dotted with small glands containing a volatile oil, upon which depends the warmth and aroma of the plants of this large and well-known family.

I. Nutlets rugose-reticulated, attached obliquely or ventrally; ovary merely 4-lobed.

Tribe I. AJUGOIDEÆ. Stamens 4, ascending and parallel, mostly exserted from the upper side of the corolla. Calyx 5–10-nerved.

* Limb of corolla irregular, seemingly unilabiate, the upper lip being either split down or very short; stamens exserted from the cleft.

1. **Teucrium.** Corolla deeply cleft between the 2 small lobes of the upper lip.

II. Nutlets smooth or granulate; scar basal, small; ovary deeply 4-parted.

Tribe II. SATUREINEÆ. Upper pair of stamens shorter or wanting; anthers 2-celled. Upper lip of corolla not galeate or concave.

* Flowers in more or less crowded clusters or whorls, axillary or spicate.

† Corolla not evidently 2-lipped, but almost equally 4-lobed, small. Stamens erect, distant.

2. **Mentha.** Fertile stamens 4, nearly equal.

3. **Lycopus.** Fertile stamens 2, and often 2 sterile filaments without anthers.

† † Corolla more or less 2-lipped.

‡ Stamens ascending or arcuate, often more or less converging.

4. **Hedeoma.** Calyx gibbous on the lower side, hairy in the throat. Flowers loose.

Tribe III. NEPETEÆ. Stamens 4, the upper (inner) pair longer than the lower, ascending or diverging. Corolla 2-lipped; the upper lip concave or arched, the lower spreading. Calyx mostly 15-nerved.

* Anthers more or less approximate in pairs; their cells divaricate or divergent; filaments ascending, not exserted.

5. **Nepeta.** Calyx more or less curved, equally 5-toothed.

Tribe IV. SCUTELLARINEÆ. Stamens 4, ascending and parallel. Calyx bilabiate, closed in fruit; the rounded lips entire. Corolla bilabiate, the upper lip arched.

6. **Scutellaria.** Calyx with a helmet-like projection on the upper side.

Tribe V. STACHYDEÆ. Stamens 4, parallel and ascending under the galeate or concave upper lip, the lower (outer) pair longer. Calyx 5–10-nerved, not 2-lipped (except in n. 7).

* Calyx reticulate-veiny, deeply bilabiate, closed in fruit.

7. **Brunella.** Calyx nerved and veiny; upper lip flat, 3-toothed, the lower 2-cleft.

* * Calyx of firmer texture, distinctly 5–10-nerved or striate, 5–10-toothed.

† Stamens ascending under the galeate upper lip of the corolla.

‡ Stamens often deflexed or contorted after anthesis.

8. **Stachys.** Calyx tubular-bell-shaped, equally 5-toothed or the 2 upper teeth united into one. Nutlets rounded at top.

1. TEUCRIUM, L. Germander.

Calyx 5-toothed. Corolla with the 4 upper lobes nearly equal, oblong, turned forward, so that there seems to be no upper lip; the lower lobe much larger. Stamens 4, exserted from the deep cleft between the 2 upper lobes of the corolla; anther-cells confluent. (Named for *Teucer*, king of Troy.)

1. **T. Canadense,** L. American Germander. Wood Sage. Perennial, *downy*, erect (1–3° high); leaves ovate-lanceolate, serrate, rounded at base, short-petioled, hoary underneath, the floral scarcely longer than the oblique unequally-toothed calyx; whorls about 6-flowered, crowded in a long and simple wand-like spike; *calyx canescent, the 3 upper lobes very obtuse* or the middle one acutish; corolla purple, rose, or sometimes cream-color (6″ long).—Low grounds; N. B. to Ont. July-September.

2. MENTHA, Tourn. Mint.

Calyx bell-shaped or tubular, 5-toothed, equal or nearly so. Corolla with a short included tube; the bell-shaped border somewhat equally 4-cleft; the upper lobe broadest, entire or notched. Stamens 4, equal, erect, distant.—Odorous perennial herbs; the small flowers mostly in close clusters, forming axillary capitate whorls, sometimes approximated in interrupted spikes, produced in summer, of two sorts as to the fertility of the stamens in most species. Corolla pale purple or whitish. Species mostly adventive or naturalized from Europe, with many hybrids. (Μίνθη of Theophrastus, from a Nymph of that name, fabled to have been changed into Mint by Proserpine.)

* *Flowers pedicellate, less crowded, in interrupted leafless spikes, or some in the upper axils; leaves petioled.*

1. **M. piperita,** L. PEPPERMINT. *Glabrous* (somewhat hairy in var. SUBHIRSUTA), very pungent-tasted; leaves ovate-oblong to oblong lanceolate, acute, sharply serrate; *spikes narrow, loose.*—Along brooks, escaped everywhere.

* * *Flowers in globular whorls or clusters, all in the axils of the leaves, the uppermost axils not flower-bearing; leaves more or less petioled; toothed.*

2. **M. Canadensis,** L. WILD MINT. *Leaves* varying from ovate-oblong to lanceolate, *tapering to both ends*; calyx oblong-bell-shaped, the teeth rather short; hairs on the stem not conspicuously reflexed. The commoner form is more or less hairy, and has nearly the odor of Pennyroyal.—Wet places, across the continent, and northward.

Var. **glabrata,** Benth. Leaves and stems almost glabrous, the former sometimes very short petioled; scent sweeter, as of Monarda.—Similar range.

3. LYCOPUS, Tourn. WATER HOREHOUND.

Calyx bell-shaped, 4–5-toothed, naked in the throat. Corolla bell-shaped, scarcely longer than the calyx, nearly equally 4-lobed. Stamens 2, distant; the upper pair either sterile rudiments or wanting. Nutlets with thickened margins.—Perennial low herbs, glabrous or puberulent, resembling Mints, with sharply toothed or pinnatifid leaves, the floral ones similar and much longer than the dense axillary whorls of small mostly white flowers; in summer. (Name compounded of λύκος, *a wolf*, and ποῦς, *foot*, from some fancied likeness in the leaves.)

* *Stoloniferous, the long filiform runners often tuberiferous; leaves only serrate.*

† *Calyx-teeth usually* 4, *barely acutish, shorter than the mature nutlets.*

1. **L. Virginicus,** L. BUGLE-WEED. Stem obtusely 4-angled (6′–2° high); leaves oblong or ovate-lanceolate, toothed, entire toward the base, acuminate at both ends, short-petioled; calyx-teeth ovate.—Shady moist places. Lab., across the continent.

* * *Not stoloniferous; leaves incised or pinnatifid.*

2. **L. sinuatus,** Ell. Stem erect, 1–3° high, acutely 4-angled; leaves oblong or lanceolate ($1\frac{1}{2}$–2′ long), acuminate, irregularly

incised or laciniate-pinnatifid, or some of the upper merely sinuate, tapering to a slender petiole; calyx-teeth short-cuspidate; sterile filaments slender, conspicuous, with globular or spatulate tips. (L. Europæus, var. sinuatus, *Gray.*)—Common.

4. HEDEOMA, Pers. Mock Pennyroyal.

Calyx ovoid or tubular, gibbous on the lower side near the base, 13-nerved, bearded in the throat, 2-lipped; upper lip 3-toothed, the lower 2-cleft. Corolla 2-lipped; upper lip erect, flat, notched at the apex, the lower spreading, 3-cleft. Fertile stamens 2; the upper pair reduced to sterile filaments or wanting.—Low, odorous annuals, with small leaves, and loose axillary clusters of flowers (in summer), often forming terminal leafy racemes. (Altered from *ἡδύοσμον*, an ancient name of Mint, from its sweet scent.)

* *Sterile filaments manifest; leaves oblong-ovate, petioled, somewhat serrate.*

1. **H. pulegioides,** Pers. American Pennyroyal. Erect, branching, hairy; whorls few-flowered; upper calyx-teeth triangular, the lower setaceous-subulate; corolla (bluish, pubescent) scarcely exserted (2–3″ long); taste and odor nearly of the true *Pennyroyal* (Mentha Pulegium) of Europe.—Common from C. B. to Ont.

5. NEPETA, L. Cat-Mint.

Calyx tubular, often incurved, obliquely 5-toothed. Corolla dilated in the throat, 2-lipped; the upper lip erect, rather concave, notched or 2-cleft; the lower spreading, 3-cleft, the middle lobe largest, either 2-lobed or entire. Stamens 4, ascending under the upper lip, the lower pair shorter; anthers approximate in pairs, the cells divergent.—Perennial herbs. (The Latin name, thought to be derived from *Nepete*, an Etrurian city.)

§ 1. *Cymose clusters rather dense and many-flowered, forming interrupted spikes or racemes; upper floral leaves small and bract-like.*

1. **N. Cataria,** L. Catnip. Downy, erect, branched; leaves heart-shaped, oblong, deeply crenate, whitish-downy underneath; corolla whitish, dotted with purple.—Near dwellings; a very common weed. July–Sept. (Nat. from Eu.)

§ 2. GLECHOMA. *Leaves all alike; the axillary clusters loosely few-flowered.*

2. **N. Glechoma,** Benth. Ground Ivy. Gill-over-the-Ground. Creeping and trailing; leaves petioled, round kidney-shaped, crenate, green both sides; corolla thrice the length of the calyx, light blue.—Damp or shady places, common. (Nat. from Eu.)

6. SCUTELLARIA, L. Skullcap.

Calyx bell-shaped in flower, 2-lipped; the lips entire, closed in fruit, the upper with a helmet-like at length concave and enlarged appendage on the back (the upper sepal); calyx splitting to the base at maturity, the upper lip usually falling away. Corolla with an elongated curved ascending tube, dilated at the throat, 2-lipped; the upper lip arched, entire or barely notched, the lateral lobes mostly connected with the upper rather than the lower lip; the lower lobe or lip spreading and convex, notched at the apex. Stamens 4, ascending under the upper lip; anthers approximate in pairs, ciliate or bearded, those of the lower stamens 1-celled (halved), of the upper 2-celled and heart-shaped.—Bitter perennial herbs, not aromatic, the short peduncles or pedicels chiefly opposite, 1-flowered, often 1-sided, axillary or spiked or racemed; in summer. (Name from *scutella*, a dish, in allusion to the appendage to the fruiting calyx.)

§ 1. *Nutlets wingless, mostly marginless, on a low gynobase.*

* *Flowers small (3″ long), in axillary and sometimes terminal 1-sided racemes.*

1. **S. lateriflora,** L. Mad-dog Skullcap. Smooth; stem upright, much branched (1–2° high); leaves lanceolate-ovate or ovate-oblong, pointed, coarsely serrate, rounded at base, petioled (2–3′ long), the lower floral ones similar; flowers blue, rarely white.—Wet shaded places, common.

* * *Flowers solitary in the axils of the upper mostly sessile leaves, which resemble the lower ones but are occasionally reduced.*

2. **S. parvula,** Michx. Herbaceous; *subterranean stolons moniliform-tuberiferous;* minutely downy, dwarf (3–6′ high), branched and spreading; all but the lower leaves sessile and entire, the lowest round-ovate, the others ovate or lance-ovate, slightly heart-

shaped (6–8″ long); corolla 2–4″ long.—Sandy banks, N.S. to Sask.

3. **S. galericulata,** L. *Herbaceous; subterranean stolons not tuberiferous*; smooth or a little downy, erect (1–2° high), simple; leaves ovate-lanceolate, acute, serrate, roundish and slightly heart-shaped at base (1–2′ long); corolla violet-blue, 8–9″ long, with slender tube, the large lower lip nearly erect.—Wet shady places; common especially northward. (Eu.)

7. BRUNELLA, Tourn. SELF-HEAL.

Calyx tubular-bell-shaped, somewhat 10-nerved and reticulated-veiny, flattened on the upper side, naked in the throat, closed in fruit, 2-lipped; upper lip broad and flat, truncate, with 3 short teeth, the lower 2-cleft. Corolla ascending, slightly contracted at the throat and dilated at the lower side just beneath it, 2-lipped; upper lip erect, arched, entire; the lower reflexed-spreading, 3-cleft, its lateral lobes oblong, the middle one rounded, concave, denticulate. Stamens 4, ascending under the upper lip; filaments 2-toothed at the apex, the lower tooth bearing the anther; anthers approximate in pairs, their cells diverging.—Low perennials, with nearly simple stems, and 3-flowered clusters of flowers sessile in the axils of round and bract-like membranaceous floral leaves, imbricated in a close spike or head. (Name said to be from the German *braune*, a disease of the throat, for which this plant was a reputed remedy.)

1. **B. vulgaris,** L. COMMON SELF-HEAL or HEAL-ALL. Leaves ovate-oblong, entire or toothed, petioled, hairy or smoothish; corolla (violet or flesh-color, rarely white) not twice the length of the purplish calyx.—Woods and fields, Newf., westward across the continent. June–Sept. (Eu.)

8. STACHYS, Tourn. HEDGE-NETTLE.

Calyx tubular-bell-shaped, 5–10-nerved, equally 5-toothed, or the upper teeth united to form an upper lip. Corolla not dilated at the throat; upper lip erect or rather spreading, often arched, entire or nearly so; the lower usually longer and spreading, 3-lobed, with the middle lobe largest and nearly entire. Stamens 4, ascending under the upper lip (often reflexed on the throat after

flowering); anthers approximate in pairs. Nutlets obtuse, not truncate.—Whorls 2–many-flowered, approximate in a terminal raceme or spike (whence the name, from *στάχυς, a spike*). Flowers purple or rose-red, in summer.

* *Root perennial; stem erect.*

† *Leaves obscurely or not at all cordate, sessile or short-petioled.*

1. **S. palustris,** L. Stem 4-angled (2–3° high), leafy, *hirsute with spreading or reflexed hairs,* especially on the angles; *leaves* sessile, or the lower short-petioled, *oblong- or ovate-lanceolate, crenately serrate,* rounded at base, *downy or hairy-pubescent,* obtusish (2–4′ long), the upper floral ones shorter than the nearly sessile calyx; whorls 6–10-flowered, the upper crowded into an interrupted spike; calyx hispid; the lance-subulate teeth somewhat spiny, half the length of the corolla, diverging in fruit; *upper lip of corolla pubescent.*—Wet ground, Newf., westward across the continent.

ORDER 54. PLANTAGINACEÆ (PLANTAIN FAMILY).

Chiefly stemless herbs, with regular 4-merous spiked flowers, the stamens inserted on the tube of the dry and membranaceous veinless monopetalous corolla, alternate with its lobes;—chiefly represented by the two following genera.

1. PLANTAGO, Tourn. PLANTAIN. RIBWORT.

Calyx of 4 imbricated persistent sepals, mostly with dry membranaceous margins. Corolla salver-form or rotate, withering on the pod, the border 4-parted. Stamens 4, or rarely 2, in all or some flowers with long and weak exserted filaments, and fugacious 2-celled anthers. Ovary 2-celled, with 1–several ovules in each cell. Style and long hairy stigma single, filiform. Capsule 2-celled, 2–several-seeded, opening transversely, so that the top falls off like a lid and the loose partition (which bears the peltate seeds) falls away. Embryo straight, in fleshy albumen.—Leaves ribbed. Flowers whitish, small, in a bracted spike or head, raised on a naked scape. (The Latin name.)

§ 1. *Stamens 4; flowers all perfect; corolla not closed over the fruit.*

* *Flowers proterogynous, the style first projecting from the unopened corolla, the anthers long-exserted after the corolla has opened; seeds not hollowed on the face (except in* P. lanceolata).

† *Corolla glabrous ; leaves strongly ribbed ; perennial.*

‡ *Ribs of the leaf free to the contracted base.*

1. **P. major,** L. COMMON PLANTAIN. Smooth or rather hairy, rarely roughish ; *leaves ovate, oblong, oval*, or slightly heart-shaped, often toothed, abruptly narrowed into a channelled petiole ; *spike dense, obtuse* ; sepals round-ovate or obovate ; *capsule ovoid, circumscissile near the middle*, 8–18-*seeded* ; *seeds angled, reticulated.*—Waysides and near dwellings everywhere. Doubtless introduced from Eu., but native from L. Superior and N. Minn., northward.

2. **P. lanceolata,** L. RIBGRASS. RIPPLEGRASS. ENGLISH PLANTAIN. Mostly hairy ; scape grooved-angled, at length much longer than the *lanceolate or lance-oblong leaves*, slender (9′–2° high) ; spike dense, at first capitate, in age cylindrical ; bract and sepals scarious, brownish ; *seeds* 2, *hollowed on the face.*—Very common. (Nat. from Eu.)

† † *Corolla-tube externally pubescent ; leaves linear or filiform, fleshy, indistinctly ribbed ; seeds* 2–4 ; *maritime, often woolly at base.*

3. **P. maritima,** L. *Perennial* ; spikes dense.—Coast of Mass. ; Gulf of St. Lawrence to Lab. and Greenland. (Eu.)

ORDER 55. PHYTOLACCACEÆ (POKEWEED FAMILY).

Plants with alternate entire leaves and perfect flowers, having the general characters of Chenopodiaceæ, *but usually a several-celled ovary composed of as many carpels united in a ring, and forming a berry in fruit.*

1. PHYTOLACCA, Tourn. POKEWEED.

Calyx of 5 rounded and petal-like sepals. Stamens 5–30. Ovary of 5–12 carpels, united in a ring, with as many short separate styles, in fruit forming a depressed-globose 5–12-celled berry, with a single vertical seed in each cell. Embryo curved in a ring around the albumen.—Tall and stout perennial herbs, with large petioled leaves, and terminal racemes which become lateral and opposite the leaves. (Name compounded of φυτόν, *plant*, and the French *lac*, lake, in allusion to the crimson coloring matter which the berries yield.)

1. **P. decandra,** L. COMMON POKE or SCOKE. GARGET. PIGEON-BERRY. Stamens and styles 10.—Low grounds. July–

Sept.—A smooth plant, with a rather unpleasant odor, and a very large poisonous root, often 4–6′ in diameter, sending up stout stalks at length 6–9° high; calyx white; ovary green, berries in long racemes, dark-purple and filled with crimson juice, ripe in autumn.

Order 56. POLYGONACEÆ (Buckwheat Family).

Herbs, with alternate entire leaves, and stipules in the form of sheaths (ocreæ, these sometimes obsolete) *above the swollen joints of the stem; the flowers mostly perfect, with a more or less persistent calyx,* a *1-celled ovary bearing 2 or 3 styles or stigmas, and a single erect orthotropous seed.* Fruit usually an achene, compressed or 3–4-angled or -winged. Embryo curved or straightish, on the outside of the albumen, or rarely in its centre. Stamens 4–12, inserted on the base of the 3–6-cleft calyx. (Juice often acrid, sometimes agreeably acid, as in Sorrel; the roots, as in Rhubarb, sometimes cathartic.)

* Flowers without involucre; stamens 4 to 8.

† Stipular sheaths manifest; ovule erect from the base of the cell.

‡ Sepals 4 or 6, the outer row reflexed, the inner erect and enlarging in fruit.

1. **Rumex.** Sepals 6. Stigmas 3. Achene 3-angled.

1. RUMEX, L. Dock. Sorrel.

Calyx of 6 sepals; the 3 outer herbaceous, sometimes united at base, spreading in fruit; the 3 inner larger, somewhat colored, enlarged after flowering (in fruit called *valves*) and convergent over the 3-angled achene, veiny, often bearing a grain-like tubercle on the back. Stamens 6. Styles 3; stigmas tufted. Embryo slightly curved, lying along one side of the albumen, slender.—Coarse herbs, with small and homely (mostly green) flowers, which are crowded and commonly whorled in panicled racemes; the petioles somewhat sheathing at base. (The ancient Latin name; of unknown etymology.)

§ 1. LAPATHUM. Dock. *Flowers perfect or monœciously polygamous; herbage not sour or scarcely so; none of the leaves halberd-shaped. (Flowering through the summer.)*

* *Perennials,* 1–7° *high, mostly with fusiform roots; valves not bearing bristles.*

† *Valves smaller, one or more of them conspicuously grain-bearing.*

‡ *Indigenous; leaves not wavy, none heart-shaped, except the lowest of n. 2.*

1. **R. salicifolius,** Weinmann. White Dock. Rather low (1–3° high); root white; *leaves narrowly or linear-lanceolate*, or the lowest oblong; whorls much crowded; *pedicels much shorter than the fruiting calyx; valves deltoid-ovate*, obtusish or acutish (about 1½″ long), one, two or sometimes all with a conspicuous often very large grain; otherwise nearly as n. 3.—Salt marshes, from Newf., far westward.

2. **R. verticillatus,** L. Swamp Dock. Rather tall (3–5° high); leaves lanceolate or oblong-lanceolate, rather obtuse, thickish, pale-green, the lowest often heart-shaped at base; racemes nearly leafless, elongated, loose, the whorls crowded or the lower ones distant; fruit-bearing *pedicels slender, club-shaped, abruptly reflexed, 3–4 times longer than the fruiting calyx; valves dilated-rhomboid, obtusely somewhat pointed, strongly rugose-reticulated*, each bearing a very large grain.—Wet swamps, common.

‡ ‡ *Naturalized European weeds; lower leaves mostly heart-shaped at base.*

3. **R. crispus,** L. Curled Dock. Smooth (3–4° high); *leaves with strongly wavy-curled margins, lanceolate*, acute, the lower truncate or scarcely heart-shaped at base; *whorls crowded in prolonged wand-like racemes, leafless above; valves round-heart-shaped, obscurely denticulate* or entire, mostly all grain-bearing.—In cultivated and waste ground, very common.

§ 2. ACETOSA. Sorrel. *Flowers diœcious, small, in a terminal naked panicle; herbage sour; some leaves halberd-shaped; smooth perennials, spreading by running rootstocks, flowering in spring.*

4. **R. Acetosella,** L. Field or Sheep Sorrel. Low (6–12′ high); leaves narrow-lanceolate or linear, halberd-form, at least those of the root, the narrow lobes entire; *pedicels jointed with the flower; valves scarcely enlarging in fruit, ovate*, naked.—Abundant everywhere. (Nat. from Eu.)

Order 57. ARISTOLOCHIACEÆ (Birthwort Family).

Twining shrubs, or low herbs, with perfect flowers, the conspicuous lurid calyx valvate in bud and coherent (at least at base) with the

6-celled ovary, which forms a many-seeded 6-celled capsule or berry in fruit. Stamens 6–12, more or less united with the style; anthers adnate, extrorse.—Leaves petioled, mostly heart-shaped and entire. Seeds anatropous, with a large fleshy rhaphe, and a minute embryo in fleshy albumen. A small family of bitter-tonic or stimulant, sometimes aromatic plants.

1. **Asarum.** Stemless herbs. Stamens 12, with more or less distinct filaments.

1. ASARUM, Tourn. Asarabacca. Wild Ginger.

Calyx regular; the limb 3-cleft or parted. Stamens 12, with more or less distinct filaments, their tips usually continued beyond the anther into a point. Capsule rather fleshy, globular, bursting irregularly or loculicidal. Seeds large, thick.—Stemless perennial herbs, with aromatic-pungent creeping rootstocks bearing 2 or 3 scales, then 1 or 2 kidney-shaped or heart-shaped leaves on long petioles, and a short-peduncled flower close to the ground in the lower axil; in spring. (An ancient name, of obscure derivation.)

§ 1. *Calyx-tube wholly adnate to the ovary, the tips inflexed in bud; filaments slender, much longer than the short anthers; style barely 6-lobed at the summit, with 6 radiating thick stigmas; leaves a single pair, unspotted.*

1. **A. Canadense,** L. Soft-pubescent; leaves membranaceous, kidney-shaped, more or less pointed (4–5′ wide when full grown); calyx bell-shaped, the upper part of the short-pointed lobes widely and abruptly spreading, brown-purple inside.—Hillsides in rich woods; common, especially northward.

Order 58. SANTALACEÆ (Sandalwood Family).

Herbs, shrubs, or trees, with entire leaves; the 4–5-cleft calyx valvate in the bud, its tube coherent with the 1-celled ovary, which contains 2–4 ovules suspended from the apex of a stalk-like free central placenta which rises from the base of the cell, but the (indehiscent) fruit always 1-seeded.—Seed destitute of any proper seed-coat. Embryo small, at the apex of copious albumen; radicle directed upward; cotyledons cylindrical. Stamens equal in number to the lobes of the calyx, and inserted opposite them into the edge of the fleshy disk at their base. Style 1. A small order, the greater part belonging to warm regions.

1. **Comandra.** Flowers perfect, in umbel-like clusters. Low herbaceous perennials.

1. COMANDRA, Nutt. Bastard Toad-flax.

Flowers perfect. Calyx bell-shaped or soon urn-shaped, lined above the ovary with an adherent disk which has a 5-lobed free border. Stamens inserted on the edge of the disk between its lobes, opposite the lobes of the calyx, to the middle of which the anthers are connected by a tuft of thread-like hairs. Fruit drupe-like or nut-like, crowned by the persistent calyx-lobes, the cavity filled by the globular seed.—Low and smooth (sometimes parasitic) perennials, with herbaceous stems from a rather woody base or root, alternate and almost sessile leaves, and greenish-white flowers in terminal or axillary small umbel-like clusters. (Name from *κόμη*, *hair*, and *ἄνδρες*, for *stamens*, in allusion to the hairs on the calyx-lobes which are attached to the anthers.)

1. **C. umbellata,** Nutt. Stems 8–10′ high, branched, very leafy; leaves oblong, pale (1′ long); *peduncles* several and *corymbose clustered at the summit, several-flowered;* calyx-tube conspicuously continued as a neck to the dry *globular-urn-shaped fruit; the lobes oblong; style slender.*—Dry ground, common. May, June. Root forming parasitic attachments to the roots of trees.

2. **C. livida,** Richardson. *Peduncles* slender, *axillary,* 3–5-*flowered,* shorter than the oval leaves; calyx-tube not continued beyond the ovary, *the lobes ovate; style short;* fruit pulpy when ripe, red.—Newf., west and northward.

Sub-Class II. MONOCOTYLEDONS or ENDOGENS.

Stems with no manifest distinction into bark, wood, and pith, but the woody fibre and vessels in bundles or threads which are irregularly imbedded in the cellular tissue; perennial trunks destitute of annual layers. Leaves mostly parallel-veined (nerved) and sheathing at the base, seldom separating by an articulation, almost always alternate or scattered and not toothed. Parts of the flower commonly in threes. Embryo with a single cotyledon, and the leaves of the plumule alternate.

ORDER 59. ORCHIDACEÆ (ORCHIS FAMILY).

Herbs, clearly distinguished by their perfect irregular flowers, with 6-merous perianth adnate to the 1-celled ovary, with innumerable ovules on 3 parietal placentæ, and with either one or two gynandrous stamens, the pollen cohering in masses. Fruit a 1-celled 3-valved capsule, with innumerable minute seeds, appearing like fine saw-dust. Perianth of 6 divisions in 2 sets; the 3 outer (*sepals*) mostly of the same petal-like texture and appearance as the 3 inner (*petals*). One of the inner set differs more or less in figure, direction, etc., from the rest, and is called the *lip;* only the other two taking the name of *petals* in the following descriptions. The lip is really the upper petal, *i.e.*, the one next to the axis, but by a twist of the ovary of half a turn it is more commonly directed forward and brought next the bract. Before the lip, in the axis of the flower, is the *column*, composed of a single stamen, or in Cypripedium of two stamens and a rudiment of a third, variously coherent with or borne on the style or thick fleshy stigma; anther 2-celled; each cell containing one or more masses of pollen *(pollinia)* or the pollen granular (in Cypripedium). Stigma a broad glutinous surface, except in Cypripedium.—Perennials, often tuber-bearing or tuberous-rooted; some epiphytes. Leaves parallel-nerved, all alternate. Flowers often showy, commonly singular in shape, solitary, racemed, or spiked, each subtended by a bract,—in all arranged for fertilization by the aid of insects, very few capable of unaided self-fertilization.

Tribe I. EPIDENDREÆ. Anther terminal, erect or inclined, operculate. Pollinia smooth and waxy, 4 or 8 (2 or 4 in each cell), distinct, or those in each cell (or all in n. 3) united at base.

* Green-foliaged plants, from solid bulbs, with 1 or 2 leaves.

† Column very short; leaf solitary.

1. **Microstylis.** Flowers racemose, minute, greenish. Petals filiform.

† † Column elongated; leaves radical.

‡ Whole plant (except the flowers) green.

2. **Liparis.** Leaves 2. Raceme few-flowered. Lip flat, entire.
3. **Calypso.** Leaf solitary. Flower large, solitary. Lip saccate.

* * Leafless, with coralloid roots; whole plant brownish or yellowish; flowers racemose.

4. **Corallorhiza.** Pollinia 4, in 2 pairs. Flower gibbous or somewhat spurred, and lip with 1-3 ridges; sepals and petals 1-3-nerved.

Tribe II. NEOTTIEÆ. Anthers erect upon the back of the column at the summit, or terminal and opercular. Pollinia granular or powdery, more or less cohering in 2 or 4 delicate masses, and attached at the apex to the beak of the stigma.

* Anthers without operculum, erect upon the back of the short column. Flowers small, in spikes or racemes.

5. **Listera.** Stem from a fibrous root, 2-foliate. Lip flat, 2-lobed.
6. **Spiranthes.** Stems leafy below, from tuberous-fascicled roots. Flowers 1–3-ranked in a twisted spike. Lip embracing the column below, with 2 callosities at base.
7. **Goodyera.** Leaves radical, white-reticulated. Lip entire, free from the column, saccate, without callosities.

* * Anther terminal, operculate, incumbent; column elongated. Stem scapose or few-leaved; flowers large, solitary or few.

8. **Arethusa.** Leaf and flower solitary. Lip bearded, its base adherent to the linear column. Pollinia 4.
9. **Calopogon.** Leaf solitary, grass-like. Lip bearded, stalked, free. Column winged at the apex. Pollinia 4.
10. **Pogonia.** More or less leafy. Lip crested, free. Column clavate. Pollinia 2.

Tribe III. OPHRYDEÆ. Anther without operculum, the cells adnate to the top of the column and often continuous with the beak of the stigma. Pollinia 2, of coarse grains united by an elastic web, each attached at base by a stalk to a viscid gland. Flower (in ours) ringent and spurred, spicate upon a leafy stem.

11. **Orchis.** The two glands or viscid disks enclosed in a common pouch.
12. **Habenaria.** The two glands naked, either approximate or widely separated.

Tribe IV. CYPRIPEDIEÆ. Perfect anthers 2, lateral, the sterile one forming a dilated fleshy appendage above the terminal stigma. Pollen granular, not in masses.

13. **Cypripedium.** Stems more or less leafy. Perianth spreading; lip an inflated sac.

1. MICROSTYLIS, Nutt. ADDER'S-MOUTH.

Sepals oblong, spreading. Petals thread-like or linear, spreading. Lip auricled or ovate at base, not tubercled, entire or nearly so. Column very small, terete, with 2 teeth or auricles at the summit and the erect anther between them. Pollen-masses 4, in one row (2 in each cell), cohering by pairs at the apex, waxy, without any stalks, threads, or gland.—Low herbs, from solid bulbs, producing simple stems, which bear in our species a single leaf and a raceme of minute greenish flowers. (Name composed of μικρός, *small*, and στυλίς, *a column* or *style*.)

1. **M. monophyllos,** Lindl. Slender (4–6′ high); leaf sheathing the base of the stem, ovate-elliptical; *racemes spiked, long and slender; pedicels not longer than the flowers;* lip long-pointed.—Cold wet swamps, N. B. to Ont., and northward. July. (Eu.)

2. **M. ophioglossoides,** Nutt. Leaf near the middle of the stem, ovate, clasping; *raceme short and obtuse; pedicels much longer than the flowers;* lip truncate-3-lobed at the summit, the middle lobe very small.—Low moist ground, N. S. to Sask. July.—Pollinia (at least sometimes) only 1 in each cell.

2. LIPARIS, Richard. Twayblade.

Sepals and petals nearly equal, linear, or the latter thread-like, spreading. Lip flat, entire, often bearing 2 tubercles above the base. Column elongated, incurved, margined at the apex. Anther lid-like, terminal; pollen-masses 4, in one row (2 to each cell), slightly united in pairs, without stalk, threads, or gland.—Small, low herbs, with solid bulbs, producing 2 root-leaves and a low scape, which bears a raceme of few purplish or greenish flowers. (Name from λιπαρός, *fat* or *shining*, in allusion to the smooth or unctuous leaves.)

1. **L. Lœselii,** Richard. Leaves elliptic-lanceolate or oblong, keeled; *lip obovate or oblong* (2″ long), mucronate, *yellowish-green, shorter than the linear unequal petals and sepals.*—Bogs, N. S. to Sask. (Eu.)

3. CALYPSO, Salisb.

Sepals and petals nearly similar, ascending, spreading, lanceolate, pointed. Lip larger than the rest of the flower, sac-shaped, inflated (9″ long), 2-pointed underneath the apex. Column broadly winged and petal-like, ovate, bearing the lid-like anther just below the apex; pollen-masses waxy, 2, each 2-parted, all sessile on a square gland.—A little bog-herb; the solid bulbs producing a single ovate or slightly heart-shaped thin leaf, as in Aplectrum, and a short (3–5′ high) scape, sheathed below, bearing a large and showy (variegated purple, pink, and yellow) flower. (Name from the goddess *Calypso.*)

1. **C. borealis,** Salisb.—Cold bogs and wet woods, the bulbs resting in moss, with a coralloid root beneath; N. S. west and northward. May.—A very local and beautiful plant. Lip somewhat resembling that of a Lady's Slipper, woolly-hairy inside. (Eu.)

4. CORALLORHIZA, Haller. Coral-root.

Perianth somewhat ringent, oblique and gibbous or obscurely spurred at base; the oblong or lanceolate sepals and petals nearly

alike, 1–3-nerved, the upper arching; the lateral sepals ascending, their bases with that of the lip forming the gibbosity or short spur which is mostly adnate to the summit of the ovary; lip slightly adherent to the base of the 2-edged straightish column, bearing a pair of projecting ridges on the face below, spreading or recurved at the apex. Anther terminal, lid-like. Pollen-masses 4, obliquely incumbent, soft-waxy, free.—Brownish or yellowish herbs, destitute of green foliage, with much-branched and toothed coral-like root-stocks (probably root-parasitical), sending up a simple scape, with sheaths in place of leaves and bearing a raceme of rather small dull-colored flowers; fruit reflexed. (Name composed of *κοράλλιον, coral,* and *ῥίζα, root.*)

§ 1. *Small spur or sac adnate to the summit of the ovary; flowers small; lip whitish or purplish, often mottled with crimson.*

1. **C. innata,** R. Brown. Plant slender, light brownish or yellowish (3–9′ high), 5–12-flowered; pedicels very short; perianth 2–2½″ long; *lip somewhat hastately* 3-*lobed above the base,* the lamellæ thick and rather short; spur a very small protuberance; capsule oval or elliptical (3–4″ long).—Swamps and damp woods, N. S. westward. May, June. (Eu.)

2. **C. multiflora,** Nutt. Plant purplish, rather stout (9–18′ high), 10–30-flowered; perianth 2½–4″ long; *lip deeply* 3-*lobed,* with a short narrowed base and with prominent lamellæ; spur manifest and protuberant; capsule oblong (6–9″ long), short pedicelled.—Dry woods, Atl. to Pacif. July–Sept.

5. **LISTERA,** R. Brown. Twayblade.

Sepals and petals nearly alike, spreading or reflexed. Lip mostly drooping, longer than the sepals, 2-lobed or 2-cleft. Column wingless; stigma with a rounded beak. Anther borne on the back of the column at the summit, erect, ovate; pollen powdery, in 2 masses, joined to a minute gland.—Roots fibrous. Stem bearing a pair of opposite sessile leaves in the middle, and a spike or raceme of greenish or brownish-purple small flowers. (Dedicated to *Martin Lister,* an early and celebrated British naturalist.)

* *Column very short; sepals ovate, reflexed; plants delicate, 4–8′ high.*

1. **L. cordata,** R. Brown. Leaves round-ovate, somewhat heart-shaped ($\frac{1}{2}$–1′ long); raceme smooth; *flowers minute, crowded, on pedicels not longer than the ovary; lip* linear, twice as long as the sepals, 1-toothed each side at base, 2-*cleft.*—Cold woods, Atl. to Pacific. June. (Eu.).

* * *Column longer, arching or straightish.*

2. **L. convallarioides,** Nutt. Plant 4–9′ high; leaves oval or roundish, and sometimes a little heart-shaped (1–1$\frac{1}{2}$′ long); raceme loose, pubescent; pedicels slender, lip wedge-oblong, 2-lobed at the dilated apex, and 1-toothed on each side at the base, nearly twice the length of the narrowly lanceolate spreading sepals, purplish, $\frac{1}{3}$′ long.—Damp mossy woods, Atl. to Pacific.

6. SPIRANTHES, Richard. Ladies' Tresses.

Perianth somewhat ringent, oblique on the ovary; the sepals and petals all narrow, mostly erect or connivent, the three upper pieces sticking together more or less, the two lower covering the base of the lip. Lip oblong, short-stalked or sessile, the lower part involute around the column, and with a callous protuberance on each side of the base; the somewhat dilated summit spreading or recurved, crisped, wavy, or rarely toothed or lobed. Column short, oblique, bearing the ovate stigma on the front, and the sessile or short-stalked (mostly acute or pointed) 2-celled erect anther on the back. Pollen-masses 2 (one in each cell), narrowly obovate, each 2-cleft, and split into thin and tender plates of granular pollen united by elastic threads, and soon adhering at base to the narrow boat-shaped viscid gland, which is set in the slender or tapering thin beak terminating the column. After the removal of the gland, the beak is left as a 2-toothed or 2-forked tip.—Roots clustered-tuberous; stem more or less naked above, leaf-bearing below or at the base. Flowers small (ours all white or greenish-white), bent horizontally, 1–3-ranked in a spike, which is commonly more or less spirally twisted (whence the name, from σπεῖρα, *a coil* or *curl*, and ἄνθος, *flower*).

* *Flowers in 3 ranks, crowded in a close spike; leaves at the root and base of the stem present at the flowering season.*

1. **S. latifolia,** Torr. Low; naked stem or scape 4–9′ (rarely 12′) high, smooth; *leaves all next the base, oblong or lance-oblong* (1–4′

long, 3–9″ wide), 3–5-nerved, contracted into a sheathing base; spike narrow (1–3′ long); *flowers small* (2–3″ long); lip quadrate-oblong, yellowish on the face, not contracted in the middle, thin, wavy-crisped at the very obtuse or truncate apex, the small *callosities* at the base *oblong, marginal and adnate* for their whole length; gland and beak of the stigma short.—Moist banks, N.B. to Ont.

2. **S. Romanzoffiana**, Cham. Stem *leafy below and leafy-bracted above* (5–15′ high); leaves varying from oblong-lanceolate to grassy-linear; spike dense, oblong or cylindrical (1–4′ long); perianth curved and the summit *manifestly ringent*, pure white (4″ long), the sepals and petals all connivent in the upper portion or galea; the *lip ovate-oblong, contracted below the rounded wavy-crenulate much recurved summit*, otherwise entire, the callosities at base globular and smooth; gland oblong-linear and the 2-horned *beak of the stigma short.*—High and cool bogs, Newf. west and northward; July, Aug. (Ireland.)

3. **S. cernua**, Richard. Stem *leafy below and leafy-bracted* above (6–20′ high); *leaves linear-lanceolate*, the lowest elongated (4–12′ long, 2–9″ wide); spike cylindrical, rather dense (2–5′ long) and with the white fragrant flowers either pubescent or nearly smooth; perianth horizontal or recurving (4–5″ long), the *lower sepals not upturned* or connivent with the upper; *lip oblong* and very obtuse when outspread, but conduplicate or the margins much incurved, wavy-crisped above the middle, especially at the flattish and recurved-spreading apex, the callosities at the base prominent, nipple-shaped, somewhat hairy; gland of the stigma linear, in a *long and very slender beak.*—Common in wet places. N.S. to Ont. Sept., Oct.

7. GOODYERA, R. Br. Rattlesnake-Plantain.

Lip sac-shaped, sessile, entire, and without callosities at base. Otherwise as Spiranthes.—Root of thick fibres, from a somewhat fleshy creeping root-stock, bearing a tuft of thickish petioled leaves, usually reticulated with white veining. Scape, spike, and the greenish-white small flowers usually glandular-downy. (Dedicated to *John Goodyear*, an early English botanist.)

§ 1. *Lip strongly saccate-inflated and with a short spreading or recurved tip; anther short, borne on a distinct filament attached to*

the back of the short column, blunt; gland-bearing tip or beak of the stigma very short.

1. **G. repens,** R. Br. Small (5–8′ high) and slender; leaves ovate, more or less white-reticulated (about 1′ long); *flowers several, in a loose 1-sided spike;* lip with an ovate recurved tip; sepals ovate.—Woods, under evergreens, common northward. July. (Eu.)

2. **G. pubescens,** R. Br. Larger; leaves strongly white-reticulated; scape 6–12′ high, *the numerous crowded flowers not one-sided;* tip of the *globular lip very short;* otherwise like the preceding, and too near to it.—Rich woods, Newf. to Ont.

8. ARETHUSA, Gronov.

Flower ringent; the lanceolate sepals and petals nearly alike, united at base, ascending and arching over the column. Lip dilated and recurved-spreading toward the summit; very slightly gibbous at base. Column adherent to the lip below, petal-like, dilated at the apex. Anther lid-like, terminal, of 2 approximate cells; pollen-masses powdery-granular, 2 in each cell.—Beautiful low herbs, consisting of a sheathed scape from a globular solid bulb, terminated usually by a single large rose-purple flower. Leaf solitary, linear, nerved, hidden in the sheaths of the scape, protruding after flowering. (Dedicated to the nymph *Arethusa.*)

1. **A. bulbosa,** L. Flower single (rarely 2), erect (1–2′ long), with an entire lip recurved at the apex and bearded-crested down the face.—Bogs, Newf. to Ont.

9. CALOPOGON, R. Br.

Flower with the ovary or stalk not twisting, therefore presenting its lip on the upper or inner side. Sepals and petals nearly alike, lance-ovate, spreading, distinct. Lip spreading, distant from the column, raised on a narrowed base or stalk, dilated at the summit, strongly bearded along the upper side. Column free, slender, winged at the apex. Anther terminal and lid-like, sessile; pollen-masses 4 (two in each cell), of soft powdery grains, lightly connected by delicate threads.—Scape from a small solid bulb, sheathed below by the base of the grass-like leaf, naked above, bearing several

large flowers. Bracts minute. (Name composed of *καλός*, *beautiful*, and *πώγων*, *beard*, from the bearded lip.)

1. **C. pulchellus**, R. Br. Leaf linear; scape about 1° high, 2–6-flowered; flowers 1′ broad, pink-purple; lip as if hinged at the insertion, beautifully bearded toward the dilated summit with white, yellow, and purple club-shaped hairs.—Bogs, Newf. to Ont.

10. POGONIA, Juss.

Flower irregular, the sepals and petals separate. Lip crested or 3-lobed. Column free, elongated, club-shaped, wingless. Anther terminal and lid-like, stalked; pollen-masses 2 (one in each cell), powdery-granular. (*Πωγωνίας*, *bearded*, from the lip of some of the original species.)

§ 1. *Sepals and petals nearly equal and alike, pale rose-color, sometimes white.*

1. **P. ophioglossoides**, Nutt. Root of thick fibres; stem (6–9′ high) bearing a single oval or lance-oblong leaf near the middle and a smaller one or bract near the terminal flower, rarely one or two others with a flower in the axil; flower 1′ long, sweet-scented; lip spatulate, appressed below to the column, beard-crested and fringed.—Bogs, Newf. to Ont. June, July. (Japan.)

11. ORCHIS, L.

Flower ringent; the sepals and petals nearly equal. Lip turned downward, coalescing with the base of the column, spurred below. Anther-cells contiguous and parallel. Pollen cohering in numerous coarse waxy grains, which are collected on a cobweb-like elastic tissue into 2 large masses (one filling each anther-cell) borne on a slender stalk, the base of which is attached to a gland or sticky disk of the stigma, the two glands contained in a common little pouch or hooded fold, placed just above the orifice of the spur. Flowers showy, in a spike.—Our species with low scape-like stems, with 1 or 2 leaves at base, from fleshy-fibrous roots. (*Ὄρχις*, the ancient name.)

1. **O. spectabilis**, L. Showy Orchis. Root of thick fleshy fibres, *producing 2 oblong-obovate shining leaves* (3–6′ long), and a few-flowered 4 angled scape (4–7′ high); bracts leaf-like, lanceolate; sepals and petals all lightly united to form the vaulted galea or

upper lip, pink-purple, the ovate undivided lip white.—Rich woods, N.B. to Ont. May.

2. **O. rotundifolia**, Pursh. Stem naked above, 1-*leaved at base* (5–9′ high), from a slender creeping rootstock; leaf varying from almost orbicular to oblong ($1\frac{1}{2}$–3′ long); flowers rose-purple, the lip white and spotted with purple, 3-lobed, and the larger middle lobe dilated and 2-lobed or strongly notched at the summit (4–6″ long), exceeding the ovate-oblong petals and sepals, and the slender depending spur. (Habenaria rotundifolia, *Richardson*.)—Damp woods and bogs, Q. west and northward.

12. **HABENARIA**, Willd. Rein-Orchis.

Glands or viscid disks (to which the pollen-masses are attached) naked and exposed, separate, sometimes widely so (becoming attached, some to the proboscis, others to the face or head of insects feeding upon the nectar of the spur, the pollen thus carried from one blossom to another); otherwise nearly as in true Orchis; the lateral sepals, however, mostly spreading. (Name from *habena*, a thong or rein, in allusion to the shape of the lip or spur of some species.)

§ 1. GYMNADENIA. *Cells of the anther parallel and approximate, their glands therefore contiguous. (Appendages of the stigma in our species two or three and much developed, oblong or club-shaped.)*

1. **H. tridentata**, Hook. Stem slender (6–12′ high), with a single oblong or oblanceolate obtuse leaf below, and 2 or 3 small ones like bracts above; spike 6–12-flowered, oblong; *flowers greenish or whitish, very small; lip wedge-oblong, truncate, and with 3 short teeth at the apex;* the slender and slightly club-shaped spur curved upward, longer than the ovary.—Wet woods, Newf. to Ont. June, July.

§ 2. PLATANTHERA. *Cells of the anther sometimes parallel, more commonly divergent, so that their tapering bases and the exposed glands are more or less distant. (Root a cluster of fleshy fibres, or tuberous-thickened.)*

* *Flowers greenish or white, small, numerous in a close spike; spur not longer than the entire or merely notched narrow lip; anther-cells almost parallel, wholly adnate; stem leafy.*

† *Spur short and sac-like; the 3 sepals and 2 narrow petals erect; glands small, rather widely separated.*

2. **H. bracteata,** R. Br. Stem 6–12′ high; lower leaves obovate, the upper oblong and gradually reduced to lanceolate acute bracts 2–4 times the length of the green flowers; spike 10–30-flowered; lip oblong-linear or slightly spatulate, truncate and 2–3-toothed or lobed at the tip, more than twice the length of the white spur. (H. viridis, var. bracteata, *Reichenb.*)—Damp woods and meadows, N. B. west and far northward.

† † *Spur slender, incurved, about equalling the entire lip; lateral sepals spreading.*

3. **H. hyperborea,** R. Br. Stem very leafy (6′–2° high); *leaves lanceolate,* erect; spike dense (2–15′ long); lower bracts lanceolate, longer than the *(greenish) flowers; lip and petals lanceolate, somewhat equal,* the latter spreading from the base; anther somewhat overhanging the transversely dilated stigma; *glands orbicular;* stalk of the pollen-masses very slender and weak.—Peat bogs and wet cold woods, Newf. west and northward. June, July. (Eu.)

4. **H. dilatata,** Gray. Resembles n. 3, but usually more slender, with narrower commonly *linear leaves; flowers white; lip lanceolate from a rhomboidal-dilated base,* entire, its base with the bases of the petals and sepals erect-connivent, above spreading; anther-cells almost parallel; *glands approximate, large and strap-shaped, vertical,* nearly as long as the pollen-mass and its short flat stalk together; stigma narrow; a trowel-shaped conspicuous beak between the bases of the anther-cells.—Cold bogs, Atl. to Pac.

* * *Flowers white or greenish, numerous in a loose spike, on a naked scape, 2-leaved at base; spur longer than the narrow entire lip; anther-cells widely diverging, their narrowed beak-like bases projecting forward; stalk of the pollen-mass laterally affixed to the back of the orbicular gland, the viscous face of which looks obliquely inward.*

5. **H. Hookeri,** Torr. Leaves orbicular, spreading (3–4′ broad); scape mostly naked ($\frac{1}{2}$–1° high), bearing 10–20 upright sessile *yellowish-green flowers in a strict spike;* sepals ovate-lanceolate; lip lanceolate, pointed, incurved, longer than the *lance-awl-shaped*

petals; spur slender, acute, about the length of the ovary (nearly 1′ long).—Damp woods and borders of swamps, N. Scotia to Ont.

6. **H. orbiculata**, Torr. Leaves very large (4–8′ wide), orbicular, spreading flat on the ground, shining above, silvery beneath; scape bracted (1–2° high), bearing many spreading *greenish-white flowers in a loose raceme;* upper sepal orbicular, the lateral ovate; *lip narrowly linear and slightly spatulate, obtuse*, drooping, nearly thrice the length of the oblong-lanceolate and falcate obtuse petals; *spur curved*, slender (about 1½′ long), gradually *thickened* toward the blunt apex, *twice the length of the ovary;* anther-cells strongly projecting at the free beak-like base (the glands nearly ¼′ apart).—Rich woods (especially coniferous), Newf. westward.

*** (Fringed Orchis.) *Flowers several or many in an open spike, with mostly foliaceous bracts; stem (rather tall) leafy; spur thread-shaped or scarcely club-shaped, longer than the fringed, cleft, or dissected lip; anther-cells widely separated and usually diverging, their narrow beak-like bases, supported by the arms of the stigma, strongly projecting forward or partly upward.*

††† (Purple Fringed-Orchis.) *Lip fan-shaped, 3-parted above the stalk-like base, the divisions erosely fringed; flowers purple; anther-cells widely separated, little divergent, the orbicular glands oblique; ovary contracted only at the summit; the long curving spur somewhat clavate.*

7. **H. psycodes**, Gray. Leaves oblong or lanceolate, the uppermost passing into linear-lanceolate bracts; *raceme cylindrical, densely many-flowered; lower sepals round-oval, obtuse; petals wedge-obovate or spatulate, denticulate above;* divisions of the spreading lip broadly wedge-shaped, many-cleft into a *short fringe.*—Wet meadows and bogs, common; Newf. to Ont. July, Aug.—Flowers short-pedicelled, crowded in a spike of 4–10′ in length, small, but very handsome, fragrant; lip short-stalked.

13. CYPRIPEDIUM, L. Lady's Slipper. Moccasin-flower.

Sepals spreading; all three distinct, or in most cases two of them united into one under the lip. Petals spreading, resembling the sepals but usually narrower. Lip a large inflated sac. Column declined; on each side a fertile stamen, with its short filament

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bearing a 2-celled anther; the pollen loose and pulpy or powdery-granular; on the upper side a dilated-triangular, petal-like but thickish body, which answers to the fertile stamen of other Orchids, and covers the summit of the style; stigma terminal, broad, obscurely 3-lobed, moist and roughish (not smooth and viscid as in the rest of the order). Pollen in most of our species, especially in n. 4, exposed by the conversion of the face of the anther into a viscid, varnish-like film, which adheres to whatever touches it, carrying away some of the pollen.—Root of many tufted fibres. Leaves large, many-nerved and plaited, sheathing at the base. Flowers solitary or few, large and showy. (Name composed of Κύπρις, *Venus*, and πόδιον, *a sock* or *buskin*, i.e., *Venus's Slipper.*)

§ 1. *Two of the sepals united into one under the lip.*

* *Stem leafy to the top, 1–3-flowered; lip slipper-shaped or roundish, much inflated, horizontal, and with a rounded open orifice.*

† *Sepals and linear wavy-twisted petals brownish, pointed, longer than the lip.*

1. **C. parviflorum,** Salisb. SMALLER YELLOW L. Stem 1–2° high, leaves oval, pointed; *sepals ovate or ovate-lanceolate; lip flattish from above, bright yellow* (1′ long or less); sterile stamen triangular.—Bogs and low woods, Newf., westward. May, June. —Flowers fragrant; sepals and petals more brown-purple than in the next, into which it seems to pass.

2. **C. pubescens,** Willd. LARGER YELLOW L. Stem 2° high, pubescent, as are the broadly oval acute leaves; *sepals elongated-lanceolate; lip flattened laterally,* very convex and gibbous above, 1½–2′ long, *pale yellow.*—Bogs and low woods; same range as the last.

†† *Sepals and petals plane, rounded, white, not longer than the lip.*

3. **C. spectabile,** Salisb. SHOWY L. Downy, 2° high; leaves ovate, pointed; sepals round-ovate or orbicular, rather longer than the oblong petals; *lip much inflated, white, pink-purple* in front (1½′ long); sterile stamen heart-ovate.—Peat-bogs, N. S. to Ont. July.—The most beautiful of the genus.

* * *Scape naked, 2-leaved at base, 1-flowered; sepals and petals greenish, shorter than the drooping lip, which has a closed fissure down its whole length in front.*

4. **C. acaule**, Ait. STEMLESS L. Downy; leaves oblong; scape 8–12′ high, with a green bract at top; sepals oblong-lanceolate, pointed, nearly as long as the linear petals; lip obovoid or oblong, rose-purple (rarely white), nearly 2′ long, veiny; sterile stamen rhomboid.—Dry or moist woods; Newf., westward. May, June.

ORDER 60. IRIDACEÆ (IRIS FAMILY).

Herbs, with equitant 2-ranked leaves, and regular or irregular perfect flowers; the divisions of the 6-cleft petal-like perianth convolute in the bud in 2 sets, the tube coherent with the 3-celled ovary, and 3 distinct or monadelphous stamens, alternate with the inner divisions of the perianth, with extrorse anthers.—Flowers from a spathe of 2 or more leaves or bracts, usually showy. Style single, usually 3-cleft; stigmas 3, opposite the cells of the ovary, or 6 by the parting of the style-branches. Capsule 3-celled, loculicidal, many-seeded. Seeds anatropous; embryo straight in fleshy albumen. Rootstocks, tubers, or corms mostly acrid.

* Branches of the style (or stigmas) opposite the anthers.

1. **Iris.** Outer divisions of the perianth recurved, the inner erect; stigmas petal-like.

* * Branches of the style alternate with the anthers. Perianth regular.

2. **Sisyrinchium.** Root fibrous. Filaments united. Stigmas thread-like.

1. IRIS, Tourn. FLOWER-DE-LUCE.

Perianth 6-cleft; the tube more or less prolonged beyond the ovary; the 3 outer divisions spreading or reflexed, the 3 inner smaller, erect. Stamens distinct; the oblong or linear anthers sheltered under the overarching petal-like stigmas (or rather branches of the style, bearing the true stigma in the form of a thin lip or plate under the apex); most of the style connate with the tube of the perianth. Capsule 3–6-angled, coriaceous. Seeds depressed-flattened, usually in 2 rows in each cell.—Perennials, with sword-shaped or grassy leaves, and large showy flowers; ours with creeping and more or less tuberous rootstocks. (Ἶρις, the *rainbow*, anciently applied to this genus on account of its bright and varied colors.)

* *Stems leafy and rather tall (1–3° high), from thickened rootstocks, often branching; tube of the perianth shorter than the divisions, which are beardless and crestless, the erect inner ones (petals) much smaller than the outer.*

† *Flowers violet-blue, variegated with green, yellow or white, and purple-veined.*

1. **I. versicolor,** L. Larger Blue Flag. Stem stout, angled on one side; *leaves sword-shaped* ($\frac{3}{4}'$ wide); ovary obtusely triangular with the sides flat; flowers ($2\frac{1}{2}$–$3'$ long) short-peduncled, the funnel-form tube shorter than the ovary; capsule oblong, turgid, with rounded angles.—Wet places, Newf. to Ont. May, June.

2. SISYRINCHIUM, L. Blue-eyed Grass.

Perianth 6-parted; the divisions alike, spreading. Stamens monadelphous to the top. Stigmas thread-like. Capsule globular, 3-angled. Seeds globular.—Low slender perennials, with fibrous roots, grassy or lanceolate leaves, mostly branching 2-edged or winged stems, and fugacious umbelled-clustered small flowers from a 2-leaved spathe. (A meaningless name, of Greek origin.)

1. **S. angustifolium,** Mill. Scape (4–12′ high) winged or wingless, *simple, the spathe solitary* and terminal, its outer bract more or less elongated; flowers delicate blue, changing to purplish (rarely white), the divisions of the perianth more or less notched, bristle-pointed and ciliate; mature *seeds* globose, *large* ($\frac{1}{2}''$ broad), faintly pitted or *nearly smooth.* (S. Bermudiana, var. mucronatum, *Gray,* excl. descr.)—Moist meadows, etc., among grass; common everywhere. June–August.

2. **S. anceps,** Cav. Scape (6–18′ high) usually branching and bearing 2 or more peduncled spathes; seeds more ovate, much smaller, deeply pitted. (S. Bermudiana, var. anceps, *Gray,* excl. descr.)—Similar localities; common.

Order 61. LILIACEÆ (Lily Family).

Herbs, or rarely woody plants, with regular and symmetrical almost always 6-androus flowers; the perianth not glumaceous, free from the chiefly 3-celled ovary; the stamens one before each of its divisions or lobes (i.e. 6, in one instance 4), *with 2-celled anthers; fruit a few-many-seeded pod or berry; the small embryo enclosed in copious albumen.* Seeds anatropous or amphitropous (orthotropous in Smilax). Flowers not from a spathe, except in Allium; the outer and inner ranks of the perianth colored alike (or nearly so) and generally similar, except in Trillium.

SUB-ORDER I. **Liliaceæ** proper. Never climbing by tendrils. Very rarely diœcious. Seeds anatropous or amphitropous.

SERIES A. Floral bracts scarious. Stamens perigynous on the usually withering-persistent nerved perianth; anthers introrse. Style undivided, mostly persistent. Fruit a loculicidal capsule or a berry. Leaves transversely veined.

* Leafy stems from running rootstocks; fruit a berry; leaves cordate to lanceolate; flowers white; pedicels jointed.

† Perianth gamophyllous, 6-lobed.

1. **Polygonatum.** Stem leafy. Flowers axillary; perianth cylindrical.

† † Perianth-segments distinct, small, spreading, persistent.

2. **Smilacina.** Stem simple, leafy. Flowers 6-parted, racemose or paniculate.
3. **Maianthemum.** Stem low, 2-leaved. Flowers 4-merous, racemose.

SERIES B. Floral bracts none or foliaceous. Stamens hypogynous or at the base of the distinct segments of the deciduous perianth (persistent in n. 11); anthers extrorse or dehiscent laterally. Style undivided, deciduous (stigmas sessile and persistent in n. 11). Fruit a loculicidal capsule or a berry. Veinlets anastomosing (transverse in n. 4, 5–7).

* Fruit a berry; stem or scape from a creeping rootstock; leaves broad, alternate or radical; flowers narrowly campanulate.

4. **Streptopus.** Stem leafy. Flowers axillary, on bent pedicels. Anthers sagittate, acute; filaments deltoid or subulate.
5. **Clintonia.** Flowers umbellate on a scape, few or many.

* * Fruit a capsule.

† Stems leafy, from a short or creeping rootstock; flowers few, solitary, pendulous; capsule few-seeded.

6. **Uvularia.** Stem terete. Leaves perfoliate. Flowers terminal. Capsule truncate, 3-lobed.
7. **Oakesia.** Stem angled. Leaves sessile. Flowers opposite the leaves. Capsule acutely 3-winged.

† † Stem or scape from a bulb or corm; capsule many-seeded.

8. **Erythronium.** Scape from a solid bulb, with a pair of leaves. Flower solitary. Seeds angled, obovoid.
9. **Lilium.** Stem leafy from a scaly bulb. Seeds horizontal, flattened.

* * * Fruit a berry; stem from a tuber-like rootstock, bearing 1 or 2 whorls of leaves; flowers terminal; stigmas sessile.

10. **Medeola.** Leaves in 2 whorls. Flowers umbellate. Perianth-segments similar, colored, deciduous.
11. **Trillium.** Leaves (3) in a terminal whorl. Flower solitary; outer sepals leaf-like, persistent.

1. POLYGONATUM, Tourn. Solomon's Seal.

Perianth cylindrical-oblong, 6-lobed at the summit; the 6 stamens inserted on or above the middle of the tube, included; anthers introrse. Ovary 3-celled, with 2–6 ovules in each cell; style slender, deciduous by a joint; stigma obtuse or capitate, obscurely 3-lobed. Berry globular, black or blue; the cells 1–2-seeded.—Perennial herbs, with simple erect or curving stems, from creeping thick and knotted rootstocks, naked below, above bearing nearly sessile or half-clasping nerved leaves, and axillary nodding greenish flowers; pedicels jointed near the flower. (The ancient name, composed of πολύς, *many*, and γόνυ, *knee*, alluding to the numerous joints of the rootstock and stem.)—Ours are alternate-leaved species, the stem terete or scarcely angled when fresh.

1. **P. biflorum,** Ell. Smaller Solomon's Seal. Glabrous, except the ovate-oblong or lance-oblong *nearly sessile leaves,* which are commonly *minutely pubescent as well as pale or glaucous underneath;* stem slender (1–3° high); *peduncles* 1–3- *but mostly 2-flowered;* perianth 4–6″ long; *filaments papillose-roughened,* inserted toward the summit of the perianth.—Wooded hillsides, N. B. to Ont.

2. SMILACINA, Desf. False Solomon's Seal.

Perianth 6-parted, spreading, withering-persistent (white). Stamens 6, inserted at the base of the divisions; filaments slender, anthers short, introrse. Ovary 3-celled, with 2 ovules in each cell; style short and thick; stigma obscurely 3-lobed. Berry globular, 1–2-seeded.—Perennial herbs, with simple stems from creeping or thickish rootstocks, alternate nerved mostly sessile leaves, and white, sometimes fragrant flowers in a terminal and simple or compound raceme. (Name a diminutive of *Smilax,* to which, however, these plants bear little resemblance.)

* *Flowers on very short pedicels in a terminal racemose panicle; stamens exceeding the small* (1″ *long*) *segments; ovules collateral; rootstock stout, fleshy.*

1. **S. racemosa,** Desf. False Spikenard. Minutely downy (1–3° high); leaves numerous, oblong or oval-lanceolate, taper-pointed, ciliate, abruptly somewhat petioled; berries pale red, speckled with purple, aromatic.—Moist copses, N. S. to Sask.

** *Flowers larger (2–3″ long), on solitary pedicels in a simple few-flowered raceme; stamens included; ovules not collateral; root-stock rather slender.*

2. **S. stellata**, Desf. Plant (1° high or less) nearly glabrous, or the 7–12 *oblong-lanceolate leaves* minutely downy beneath when young, slightly clasping; raceme sessile or nearly so; *berries blackish.*—Moist banks, Lab. and westward. (Eu.)

3. **S. trifolia**, Desf. Glabrous, *dwarf* (2–6′ high); *leaves* 3 (sometimes 2 or 4), oblong, tapering to a *sheathing base;* raceme peduncled; *berries red.*—Cold bogs, Lab. to Pac. (Sib.)

3. MAIANTHEMUM, Wigg.

Perianth 4-parted, with as many stamens. Ovary 2-celled; stigma 2-lobed. Otherwise as in Smilacina.—Flowers solitary or fascicled, in a simple raceme upon a low 2–3-leaved stem. Leaves ovate- to lanceolate-cordate. (Name from *Maius*, May, and ἄνθεμον, *a flower.*)

1. **M. Canadense**, Desf. Pubescent or glabrous (3–5′ high); leaves lanceolate to ovate, cordate at base with a very narrow sinus, sessile or very shortly petioled; perianth-segments 1″ long. (Smilacina bifolia, var. Canadensis, *Gray.*)—Moist woods, Lab. to R. Mts. May.

4. STREPTOPUS, Michx. Twisted-Stalk.

Perianth recurved-spreading from a bell-shaped base, deciduous; the 6 distinct sepals lanceolate, acute, the 3 inner keeled. Anthers arrow-shaped, extrorse, fixed near the base to the short flattened filaments, tapering above to a slender entire or 2-cleft point. Ovary with many ovules in each cell; style and sometimes the stigmas one. Berry red, roundish-ovoid, many-seeded.—Herbs, with rather stout stems from a creeping rootstock, forking and divergent branches, ovate and taper-pointed round-clasping membranaceous leaves, and small (extra-) axillary flowers, either solitary or in pairs, on slender thread-like peduncles, which are abruptly bent or contorted near the middle (whence the name, from στρεπτός, *twisted,* and ποῦς, *foot* or *stalk*).

1. **S. amplexifolius**, DC. Stem 2–3° high, glabrous; *leaves very smooth, glaucous underneath,* strongly clasping; *flower greenish-*

white (4–6″ long) on a long abruptly bent peduncle; anthers tapering to a slender entire point; *stigma entire, truncate.*—Cold moist woods, Lab. to Pac. June. (Eu.)

2. **S. roseus,** Michx. *Lower leaves green both sides, finely ciliate,* and the branches sparingly beset with short bristly hairs; *flower rose-purple* (3–4″ long), more than half the length of the slightly bent peduncle; anthers 2-horned; *stigma 3-cleft.*—Cold damp woods, Lab. to R. Mts. May.

5. CLINTONIA, Raf.

Perianth of 6 separate sepals, bell-shaped, lily-like, deciduous; the 6 stamens inserted at their base. Filaments long and thread-like; anthers linear or oblong, extrorsely fixed by a point above the base, the cells opening down the margins. Ovary ovoid-oblong, 2–3-celled; style long; stigmas 2 or 3, or in ours united into one. Berry few–many-seeded.—Short-stemmed perennials, with slender creeping rootstocks, bearing a naked peduncle sheathed at the base by the stalks of 2–4 large oblong or oval ciliate leaves; flowers rather large, umbelled, rarely single. (Dedicated to *De Witt Clinton.*)

1. **C. borealis,** Raf. Scape and leaves 5–8′ long; *umbel 3–6-flowered;* perianth greenish-yellow, somewhat downy outside (3–4″ long); berry ovoid, blue; *ovules 20 or more.*—Cold moist woods, Lab. to Sask.

6. UVULARIA, L. Bellwort.

Perianth narrowly bell-shaped, lily-like, deciduous; the 6 distinct sepals spatulate-lanceolate, acuminate, obtusely gibbous at base, with a deep honey-bearing groove within bordered on each side by a callus-like ridge. Stamens much shorter, barely adherent to their base; anthers linear, much longer than the filaments, adnate and extrorse, but the long narrow cells opening laterally. Style deeply 3-cleft; the divisions stigmatic along the inner side. Capsule truncate, coriaceous, 3-lobed, loculicidal at the summit. Seeds few in each cell, obovoid, with a thin white aril.—Stems rather low, terete, from a short rootstock with fleshy roots, naked or scaly at base, forking above, bearing oblong perfoliate flat and membranaceous leaves with smooth margins, and yellowish drooping

flowers, in spring, solitary on terminal peduncles. (Name "from the flowers hanging like the *uvula*, or palate.")

1. **U. grandiflora,** Smith. Yellowish-green, *not glaucous;* stem naked or with a single leaf below the fork; *leaves whitish-pubescent beneath*, usually somewhat acuminate; *perianth-segments smooth within* or nearly so (12–18″ long); *stamens exceeding the styles, obtusely tipped;* capsule obtusely lobed. (U. flava, *Smith.*)—Rich woods, Q. and Ont.

7. OAKESIA, Watson.

Flowers resembling those of Uvularia, but the segments obtuse or acutish, carinately gibbous and without ridges within. Capsule membranous, elliptical, acutish at each end or shortly stipitate, triquetrous and acutely winged, very tardily dehiscent. Seeds globose, with a very tumid spongy rhaphe.—Stem acutely angled, from a slender creeping rootstock, with sessile clasping leaves scabrous on the margin, and 1 or 2 flowers terminal on slender peduncles but soon appearing opposite to the leaves by the growth of the branches. (Dedicated to *William Oakes.*)

1. **O. sessilifolia,** Watson. Leaves lance-oblong, acute at each end, pale, glaucous beneath, sessile or partly clasping; sepals 7–12″ long; anthers obtuse; capsule short-stipitate, 6–10″ long. (Uvularia sessilifolia, *L.*)—Low woods, Q. to Ont.

8. ERYTHRONIUM, L. Dog's-tooth Violet.

Perianth lily-like, of 6 distinct lanceolate sepals, recurved or spreading above, deciduous, the 3 inner usually with a callous tooth on each side of the erect base, and a groove in the middle. Filaments 6, awl-shaped; anthers oblong-linear, continuing erect. Style elongated. Capsule obovate, contracted at base, 3-valved, loculicidal. Seeds rather numerous, ovoid, with a loose membranaceous tip.—Nearly stemless herbs, with two smooth and shining flat leaves tapering into petioles and sheathing the base of the commonly one-flowered scape, rising from a deep solid-scaly bulb. Flowers rather large, nodding, in spring. (The Greek name for the purple-flowered European species, from ἐρυθρός, *red.*)

1. **E. Americanum,** Ker. Yellow Adder's-tongue. Scape 6–9′ high; leaves elliptical-lanceolate, pale green, mottled with

purplish and whitish and commonly minutely dotted; *perianth light yellow*, often spotted near the base (10–20″ long); style club-shaped; *stigmas united.*—Rich ground, N. Brunswick to Ont.

9. LILIUM, L. Lily.

Perianth funnel-form or bell-shaped, colored, of 6 distinct sepals, spreading or recurved above, with a honey-bearing furrow at the base, deciduous; the 6 stamens somewhat adhering to their bases. Anthers linear, extrorsely attached near the middle to the tapering apex of the long filament, which is at first included, at length versatile; the cells dehiscent by a lateral or slightly introrse line. Style elongated, somewhat club-shaped; stigma 3-lobed. Capsule oblong, containing numerous flat and horizontal (depressed) soft-coated seeds densely packed in 2 rows in each cell. Bulbs scaly, producing simple stems, with numerous alternate-scattered or whorled narrow sessile leaves, and from one to several large and showy flowers; in summer. (The classical Latin name, from the Greek λείριον.)

* *Flowers erect, the sepals narrowed below into claws; bulbs not rhizomatous.*

1. **L. Philadelphicum,** L. Wild Orange-red Lily. Wood Lily. Stems 2–3° high; *leaves linear-lanceolate, whorled or scattered;* flowers (2–4′ long) 1–3, open-bell-shaped, *reddish-orange* spotted with purplish inside; the lanceolate sepals not recurved at the summit; bulb of thick fleshy jointed scales.—Dry or sandy ground, Q., westward.

* * *Flowers nodding, the sepals sessile; bulbs rhizomatous.*

2. **L. Canadense,** L. Wild Yellow Lily. Stem 2–7° high; *leaves remotely whorled,* lanceolate, strongly 3-nerved, the margins and nerves rough; flowers few (2–3′ long), long-peduncled, oblong-bell-shaped, the *sepals recurved-spreading above,* yellow or orange, usually spotted with brown.—Moist meadows and bogs, N. S. to Ontario.

10. MEDEOLA, Gronov. Indian Cucumber-root.

Perianth recurved, the 3 sepals and 3 petals oblong and alike (pale greenish-yellow), deciduous. Stamens 6; anthers shorter than the slender filaments, oblong, extrorsely attached above the

base, but the line of dehiscence of the closely contiguous parallel cells lateral or slightly introrse. Stigmas, or styles, stigmatic down the upper side, recurved-diverging from the globose ovary, long and thread-form, deciduous. Berry globose (dark purple), 3-celled, few-seeded.—A perennial herb, with a simple slender stem (1–3° high, clothed with flocculent and deciduous wool), rising from a horizontal and tuberous white rootstock (which has the taste of cucumber), bearing near the middle a whorl of 5–9 obovate-lanceolate and pointed, sessile, lightly paralled-ribbed and netted-veiny, thin leaves; also another of 3 (rarely 4 or 5) much smaller ovate ones at the top, subtending a sessile umbel of small recurved flowers. (Named after the sorceress *Medea*, for its supposed great medicinal virtues.)

1. **M. Virginiana**, L.—Rich damp woods, N. S. to Ont. June.

11. TRILLIUM, L. Wake Robin. Birthroot.

Sepals 3, lanceolate, spreading, herbaceous, persistent. Petals 3, larger, withering in age. Stamens 6; anthers linear, on short filaments, adnate, usually introrse; the cells opening down the margins. Stigmas sessile, awl-shaped or slender, spreading or recurved above, persistent, stigmatic down the inner side. Ovary 3–6-angled. Berry ovate, usually 6-angled or -winged, 3-celled (purple or red). Seeds ovate, horizontal, several in each cell.—Low perennial herbs, with a stout and simple stem rising from a short and præmorse tuber-like rootstock, naked, bearing at the summit a whorl of 3 ample, commonly broadly ovate, more or less ribbed but netted-veined leaves, and a terminal large flower; in spring. (Name from *triplum*, triple; all the parts being in threes.)—Monstrosities are not rare with the calyx and sometimes petals changed to leaves, or the parts of the flower increased in number.

* *Ovary and fruit 6-angled and more or less winged.*

† *Flower pedicelled; connective narrow, not produced; leaves subsessile.*

‡ *Pedicel longer than the flower; filament shorter than the anther.*

1. **T. erectum**, L. Leaves very broadly rhombic ($2\frac{1}{2}$–6′ wide), shortly acuminate; pedicel (1–3′ long) usually more or less inclined or declinate; *petals ovate to lanceolate* (9–18″ long), brown-purple or

often white or greenish or pinkish; stamens equalling or exceeding the *stout distinct spreading or recurved stigmas;* fruit ovate, 1′ long, reddish.—Rich woods, N. Scotia to Ont. Flowers ill-scented.

2. **T. grandiflorum**, Salisb. Leaves less broadly rhombic-ovate (1½–4′ wide); pedicel erect or ascending; *petals oblanceolate,* often broadly so (1½–2½′ long), white turning rose-color or marked with green; stamens with stout filaments (persistently green about the fruit) and anthers, *exceeding the very slender erect or suberect and somewhat coherent stigmas;* fruit globose, ½–1′ long.—Rich woods, Q. and Ont.

‡ ‡ *Pedicel short, recurved or strongly declinate; filaments slender, about equalling the anther.*

3. **T. cernuum**, L. Leaves very broadly rhombic-ovate (2–4′ broad); petals white or pink, ovate- to oblong-lanceolate (6–12″ long), wavy, recurved-spreading; stamens with short anthers, shorter than the stout recurved distinct stigmas; fruit ovate.—Moist woods, N.S. to Ont.

** *Ovary and fruit 3-lobed or angled, not winged; filaments slender, about equalling the anthers; pedicel erect or inclined; leaves petiolate.*

4. **T. erythrocarpum**, Michx. Painted T. *Leaves ovate, taper-pointed; petals ovate or oval-lanceolate, pointed, wavy,* widely spreading, *white painted with purple stripes at the base,* shorter than the peduncle; fruit broad-ovate, obtuse, 7–9″ long.—Cold damp woods and bogs, N.S. to Ont.

Order 62. ARACEÆ (Arum Family).

Plants with acrid or pungent juice, simple or compound often veiny leaves, and flowers crowded on a spadix, which is usually surrounded by a spathe.—Floral envelopes none, or of 4–6 sepals. Fruit usually a berry. Seeds with fleshy albumen, or none, but filled with the large fleshy embryo. A large family, chiefly tropical. Herbage abounding in slender rhaphides.—The genuine Araceæ have no floral envelopes, and are almost all monœcious or diœcious; but the genera of the second section, with more highly developed flowers, are not to be separated.

* Spathe surrounding or subtending the spadix; flowers naked, *i.e.*, without perianth.

1. **Arisæma.** Flowers monœcious or diœcious, covering only the base of the spadix.
2. **Calla.** Flowers perfect (at least the lower ones), covering the whole of the short spadix. Spathe open and spreading.

* * Spathe surrounding the spadix in n. 3, none or imperfect in the rest; flowers with a calyx or perianth and perfect, covering the whole spadix.

3. **Symplocarpus.** Spadix globular, in a fleshy shell-shaped spathe. Stemless.

1. ARISÆMA, Martius. Indian Turnip. Dragon Arum.

Spathe convolute below and mostly arched above. Flowers monœcious or by abortion diœcious, covering only the base of the spadix, which is elongated and naked above. Floral envelopes none. Sterile flowers above the fertile, each of a cluster of almost sessile 2–4-celled anthers, opening by pores or chinks at the top. Fertile flowers consisting each of a 1-celled ovary, tipped with a depressed stigma, and containing 5 or 6 orthotropous ovules erect from the base of the cell; in fruit a 1–few-seeded scarlet berry. Embryo in the axis of albumen.—Low perennial herbs, with a tuberous rootstock or corm, sending up a simple scape sheathed with the petioles of the simple or compound veiny leaves. (Name from ἀρίς, a kind of *arum*, and αἷμα, *blood*, from the spotted leaves of some species.)

1. **A. triphyllum,** Torr. Indian Turnip. *Leaves mostly 2, divided into 3 elliptical-ovate pointed leaflets; spadix mostly diœcious, club-shaped,* obtuse, much shorter than the spathe, which is flattened and incurved-hooded at the ovate-lanceolate, pointed summit.—Rich woods, N. S. to Ont. May.—Corm turnip-shaped, wrinkled, farinaceous, with an intensely acrid juice; spathe with the petioles and sheaths green, or often variegated with dark purple and whitish stripes or spots.

2. CALLA, L. Water Arum.

Spathe open and spreading, ovate (abruptly pointed, the upper surface white), persistent. Spadix oblong, entirely covered with flowers; the lower perfect and 6-androus; the upper often of stamens only. Floral envelopes none. Filaments slender; anthers 2-celled, opening lengthwise. Ovary 1-celled, with 5–9 erect anatropous ovules; stigma almost sessile. Berries (red) distinct, few-seeded. Seeds with a conspicuous rhaphe and an embryo

nearly the length of the hard albumen.—A low perennial herb, growing in cold bogs, with a long creeping rootstock, bearing heart-shaped long-petioled leaves, and solitary scapes. (An ancient name, of unknown meaning.)

1. **C. palustris,** L.—Cold bogs, N.S. west and northward. June.—Seeds surrounded with jelly. (Eu.)

3. SYMPLOCARPUS, Salisb. Skunk Cabbage.

Spathe hooded-shell-form, pointed, very thick and fleshy, decaying in fruit. Spadix globular, short-stalked, entirely and densely covered with perfect flowers, their 1-celled or abortively 2-celled ovaries immersed in the fleshy receptacle. Sepals 4, hooded. Stamens 4, opposite the sepals, with at length rather slender filaments; anthers extrorse, 2-celled, opening lengthwise. Style 4-angled and awl-shaped; stigma small. Ovule solitary, suspended, anatropous. Fruit a globular or oval mass, composed of the enlarged and spongy spadix, enclosing the spherical seeds just beneath the surface, which is roughened with the persistent fleshy sepals and pyramidal styles. Seeds filled by the large globular and fleshy corm-like embryo, which bears one or several plumules at the end next the base of the ovary; albumen none.—Perennial herb, with a strong odor like that of the skunk, and also somewhat alliaceous; a very thick rootstock, bearing a multitude of long and coarse fibrous roots and a cluster of very large and broad entire veiny leaves, preceded in earliest spring by the nearly sessile spathes, which barely rise out of the ground. (Name from *συμπλοκή*, *connection*, and *καρπός*, *fruit*, in allusion to the coalescence of the ovaries into a compound fruit.)

1. **S. fœtidus,** Salisb. Leaves ovate, cordate, becoming 1–2° long, short-petioled; spathe spotted and striped with purple and yellowish-green, ovate, incurved; fruit (in autumn) 2–3′ in diam., in decay shedding the bulblet-like seeds, which are 4–6″ long.—Bogs and moist grounds, N. Scotia to Ont.

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